AD-A172 320 FUNDAMENTALS OF A GROUP TECHNOLOGY ELECTRONICS CLASSIFICATION AND CODING..(U) ORGANIZATION FOR INDUSTRIAL RESEARCH INC WALTHAM MA P CHEVALIER ET AL. 1/2

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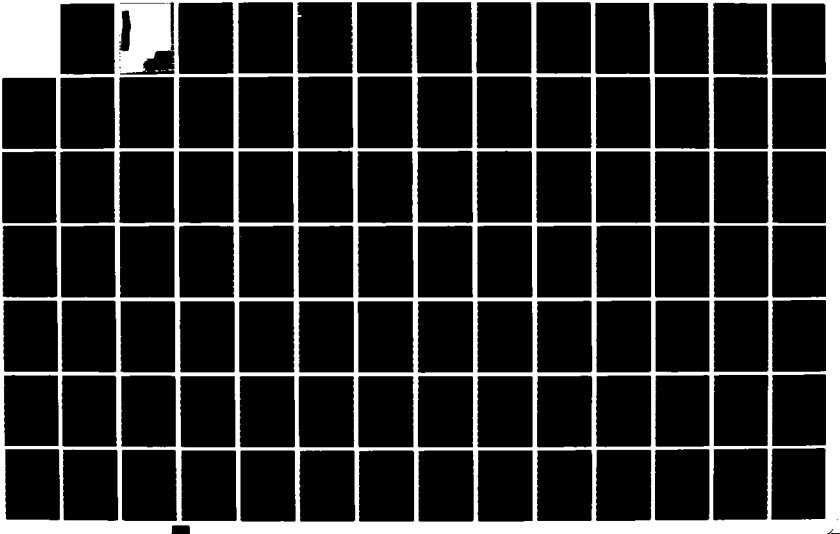

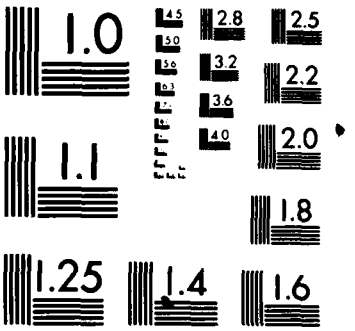

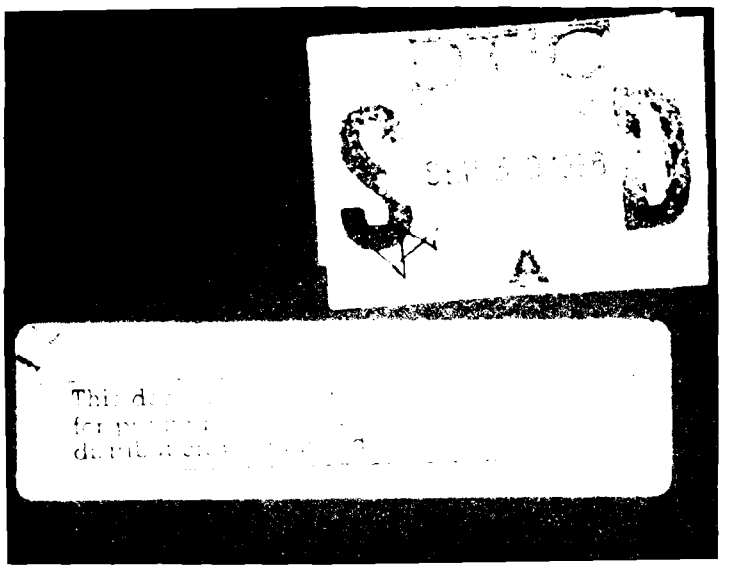

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report documents a survey of Electronics Manufacturers conducted by Organization for Industrial Research, Inc. The objective of the study was to identify the fundamentals of a Group Technology Electronics Classification and Coding System. Included in the report are details of survey development and administration, tabulation of responses, data validation procedures and conclusions reached through data analysis. This report is supported by Report DAAK10-80-C-0189 ECACS-Requirements Definition.

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Report DAAK10-80-C-0189

FUNDAMENTALS OF A GROUP TECHNOLOGY ELECTRONICS CLASSIFICATION AND CODING SYSTEM

Summary of Survey Findings

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5 April 1982

Final Report

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Prepared for

DEPARTMENT OF THE ARMY
U.S. Army Armament R&D Command
Dover, New Jersey 07801

PREFACE

Contract NO. DAAK10-80-C-0189 was awarded by the Tri-Service Manufacturing Technology Program through the Department of the Army, U.S. Armament R&D Command, Dover, New Jersey to the Organization for Industrial Research, Inc. (OIR) in order to identify the fundamentals of a Group Technology Electronics Classification and Coding System.

The major task of this contract required OIR to survey the electronics industry in order to identify these fundamentals. This report details the survey findings, and draws conclusions from the data. Additionally these survey findings will be used to produce the requirements definition for the fundamentals of a Group Technology Electronics Classification and Coding System.

OIR cautions the reader to review this report and view the data as the beginning of the process, rather than an end in itself. The size of the survey population is small (26 companies, 49 individual respondents) but OIR believes it is representative of industry opinion.

This survey has identified valuable data which clearly defines the general direction for the future development of a Group Technology Electronics Classification and Coding System. However, OIR is acutely aware that many issues raised by the survey , need further exploration.

SUMMARY

Contract No. DAAK10-80-C-0189 required OIR to identify the Fundamental Characteristics of a Group Technology "Electronics Classification and Coding System" (ECACS). This document reports the activities and results of the contract. The following is a brief summary of the contents of this report.

Group Technology is rapidly becoming recognized as a major factor in the integration of Computer Aided Design and Computer Aided Manufacturing. A Group Technology classification and coding system is used as the common identifier for accessing integrated and/or multiple databases. In order to apply Group Technology principles to electronics manufacture, the logical first step is to develop an ECACS. However, before code development can begin, it is necessary to define the specific information which should be captured by the code.

OIR has surveyed twenty-six companies with the objective of identifying:

- The primary and secondary information vital to an ECACS;
- The areas of greatest interest for the application of an ECACS.

Companies surveyed included ICAM/ECAM interest group members, OIR clients, and companies suggested by the panel of electronics experts which joined OIR's project team.

The questionnaire (which was developed using research material and a project team with expertise in electronics, manufacturing/ engineering, Group Technology and survey design) consisted of thirty-seven questions in a "forced - response" format. After receiving the completed surveys and conducting an in-depth technical review and analysis of the data, ten companies were selected for on-site interviews to validate the initial survey data. A team consisting of an electronics expert and a Group Technology expert conducted these interviews.

The following is offered as highlights of the conclusions reached as a result of the survey and the validation process:

- Manufacturing/test engineering was the largest group in the sample population, 70%.
- Only 12% of total sample population work or have worked with the concept of Group Technology.

- 80% of the respondent companies were attempting to deal with the issue of standardization.
- No formal application of ECACS was found.
- Average productivity of 25%, for design and manufacturing engineers was attributed to informal support systems and the resulting time spent in data search.
- Primary applications of an ECACS included printed circuit boards, board assemblies, electro-mechanical assemblies, wired assemblies, and discrete components.
- Main concern of design engineers was the fast retrieval of existing designs.
- Main concern of manufacturing engineers included graphics, referencing "master" process plans, and retrieving quality, performance, and obsolescence data.

The concensus of the respondents, believed the primary advantages of using an ECACS, included:

- lower overall product costs,
- increased manufacturing efficiency,
- shortened elapsed times between design and production,
- better utilization of existing designs and processes, and
- increased design productivity.

The need for Group Technology applications and an ECACS in electronics manufacturing clearly exists; with the careful consideration of the type of data to be retrieved being most critical. This is evidenced by the numerous efforts underway in all companies visited.

The feasibility of developing an ECACS with industry-wide appeal is fast becoming a reality. The construction of such a code will be a major project which requires the cooperation of both the electronics industry and Group Technology expertise. The anticipated significant increases in productivity and cost savings which will be generated by Group Technology applications in the electronics industry, will make this a high priority project.

TABLE OF CONTENTS

Section 1

INTRODUCTION

This report documents the activities and the findings of DOD Contract No. DAAK10-80-C-0189, awarded by the Tri-Service Manufacturing Technology Program through the Department of the Army, U.S. Army Armament R&D Command, Dover, New Jersey to the Organization for Industrial Research, Inc. (OIR).

Contract No. DAAK10-80-C-0189 required OIR to develop a description of the Fundamental Characteristics of a Group Technology "Electronics Classification and Coding System"(ECACS) including a requirements definition. As part of contract activities, OIR was commissioned to survey electronics manufacturers regarding the parameters for an ECACS.

This report is divided into sections which provide the historical context of the project, outline of project activities, details of survey development, survey findings, and validation of survey data. All support documentation can be found in the appendices.

The detailed requirements definition called for by Contract No. DAAK10-80-C-0189 can be found in a separate report entitled "Requirements Definition for a Group Technology Electronics Classification and Coding System".

Those readers interested in:

- an overview of the project are directed to Section 3.
- survey development and administration are directed to Section 4 and Appendices A-C.
- survey results are directed to Sections 5 and 7.

Section 2

BACKGROUND

Many corporations and U.S. Government organizations have expressed strong interest in the application of the principles of Group Technology to the electronics industry. This interest appears to encompass the design, manufacture and test of electronic components. However, there is a diversity of opinion regarding the method of applying Group Technology principles within the electronics industry.

Traditionally, Group Technology was defined in terms of its usefulness in improving efficiencies in batch manufacturing machine shop operations. Currently, Group Technology is becoming recognized as a key element in the integration of Computer Aided Design and Computer Aided Manufacturing. Essential to the application of Group Technology as the link between CAD and CAM systems, is a well structured and developed classification and coding system.

The classification and coding system becomes the method for organizing (grouping) data so that it can be retrieved quickly by multiple users. The code number is the main identifier for accessing an integrated database or multiple databases. Therefore, it is crucial to identify the specific information a classification and coding system needs to capture, in order to facilitate speedy retrieval of required data necessary for various Group Technology applications serving multiple users.

As Group Technology moves out of the confines of the machine shop and into the area of electronics manufacture, a classification and coding system specifically designed for electronics must be developed. Currently no such coding system exists.

Recognizing the potential benefits of Group Technology applications in electronics manufacture, the Tri-Services Manufacturing Technology Program, through the U.S. Army Armament R&D Command, Dover, New Jersey awarded Contract No. DAAK10-80-C-0189 to the Organization for Industrial Research.

The U.S. Army Armament R&D Command had previous experience in the application of a Group Technology classification and coding system (MICLASS) for machined parts and has realized substantial benefits using this coding system for various applications (i.e. automated process planning-MIPLAN). The Department of the Army has also implemented the MICLASS-MIPLAN-MIGROUP Systems at the Rock Island and Watervliet Arsenals. The interest in bringing the benefits of Group Technology to electronics manufacture was a logical

extension of these efforts. The MICLASS-MIPLAN-MIGROUP Systems were procured by the Department of the Army for use at these facilities. System implementation was performed by OIR.

The Organization for Industrial Research is a company committed to the philosophy of Group Technology. However, OIR believes in realistic and practical applications of Group Technology within manufacturing and has over fifty American customers and seventy installations of its systems as confirmation of its philosophy and approach.

An important segment of OIR's Technical expertise is code development. OIR's Group Technology consultants are skilled in code design, structure, and layout, and have developed specific coding systems to meet client requirements. Additionally, OIR has proprietary computerized Group Technology Analysis Programs (MIGROUP) which are important tools used for code development and validation. These automated programs significantly reduce the time necessary to develop a Group Technology classification and coding system.

OIR strongly believes in an integrated approach to CAD and CAM systems. Over ten years of practical, on-site experience has unequivocally demonstrated the benefits of an integrated systems approach rather than numerous systems in isolation. Group Technology can become "glue" technology and be the essential ingredient in achieving integration of CAD and CAM systems. OIR has shown that a Group Technology classification and coding system can become the common denominator among different CAD/CAM systems and applications. The MICLASS Code is at the core of all OIR Systems.

Given the background and experience of both the U.S. Army Armament R&D Command and OIR, a Group Technology Electronics Classification and Coding System is a natural first priority for bringing Group Technology principles to electronics manufacture.

In order to identify the fundamentals of an ECACS, the contract required OIR to survey manufacturers within the electronics industry, analyze the survey data and then return to the field and validate the survey data. Because of the constantly evolving technology found in this industry, the government wanted to insure the accuracy and currency of the data identified by the survey. The validation process allowed OIR to explore all areas of interest as indicated by the questionnaire, in greater detail.

The following report outlines the procedures, findings and conclusions of the survey activity and becomes the basis for the ECACS Requirements Definition.

Section 3

PROJECT OUTLINE

Contract No. DAAK10-80-C-0189 required a survey of electronics manufacturers in order to facilitate the definition of those characteristics fundamental to a Group Technology Electronics Classification and Coding System. The following outlines the major activities in support of the contract.

3.1 Identification and Recruitment of Technical Team

OIR identified professional staff in-house to become the nucleus of the project team and assigned a project manager. Additionally, OIR recognized the need for electronics design/manufacturing expertise and recruited experts within the electronics industry to become part of or consult with the project team.

3.2 Development of Implementation Plan and Schedule

Project Team met and decided upon an implementation plan and schedule to meet contract requirements. The following is an outline of the project plan:

- Develop a questionnaire to complete an initial survey of the electronics industry (at least 20 companies) by distributing a written questionnaire.
- Collect and analyze data from returned questionnaires. Using this data analysis, develop a structured interview to be used for ten (10) on-site visits to electronics manufacturers.
- Interview, on-site, ten (10) electronics manufacturers to validate initial data analysis and collect any additional information necessary for the development of an electronics classification and coding system.
- Collect and analyze data from on-site interviews.
- Write final reports and specifications for electronics classification and coding system development.

3.3 Data Gathering

Project Team members identified and collected appropriate research sources and materials for electronics design, manufacture, and testing. Manuals, catalogs, military standards, etc. were used to identify basic information

necessary for the development of a questionnaire to fulfill survey requirements.

3.4 The details of:

- questionnaire development;
- survey distribution and administration;
- survey findings;
- and survey data validation

will be found in subsequent sections of this report.

Section 4

SURVEY DEVELOPMENT AND DISTRIBUTION

In any survey, there are many alternatives pertaining to objectives, sampling population, questionnaire format, questions, and mode of distribution. The decisions reached by OIR, in each of these areas, are presented in the following sections.

4.1 Objectives

Five survey objectives were defined in order to design a questionnaire which would identify the primary and secondary information which should be captured by an Electronics Classification and Coding System (ECACS).

- Identify those areas, or families, within electronics design and manufacture, which would be candidates for ECACS.
- Identify the possible characteristics of those areas, or families, which would be essential to design and/or manufacture.
- Identify the characteristics of the test and evaluation processes associated with electronics design and manufacture.
- Identify those areas of greatest interest for applications of ECACS.
- Identify primary advantages perceived as the result of using an ECACS.

As the particular questions were formulated and reviewed, each one was assessed regarding its contribution toward meeting these objectives.

4.2 Sampling Population

Many categories of potential survey participants were considered in defining the sampling population to be involved in the survey. Among these were:

- ICAM Electronics CAD/CAM Interest Group
- ECAM Coalition Participants
- OIR Client Listings
- Companies suggested by the panel of electronics design/manufacturing experts.

The sampling population that was decided upon consisted of companies from each category. The sample also provided a collection of companies having a varying mix of military and commercial products.

It became apparent, based on the objectives of the survey, that there were two, possibly three, professional disciplines whose input should be sought. These included Design Engineers, Manufacturing (Process) Engineers, and, in some cases, Test Engineers. The latter position is most often found within the Manufacturing Engineering Group. Qualifying representatives from these areas, were specifically solicited.

4.3 Question Format

The questionnaires were designed in a "forced response" format (specific short choices for each answer) to facilitate completion of the questionnaire by the respondent, and to allow convenient tabulation of responses. A few open-ended, expository questions were included in order to capture nuances of opinion and other possibly valuable unpredictable information.

Demographic data was also requested by the questionnaire so as to permit the qualification of responses.

4.4 Development of the Questionnaire

The most creative and challenging aspect of questionnaire development was the formulation, review and modification of questions to be asked of the sampling population.

Using research materials, an initial draft of the questionnaire was developed. This draft was reviewed by project team members with expertise in:

- electronics engineering,
- electronics manufacture,
- Group Technology Classification and Coding,
- survey/questionnaire design.

The initial draft was edited and rewritten to reflect this technical input.

The revised draft was then used with professional staff at three electronics manufacturers. These participants provided OIR with a trial sample. Project team members interviewed the questionnaire participants and collected additional technical information.

The project team met, reviewed the trial sample results/ comments, and edited the questionnaire to reflect this

additional information. The finalized questionnaire was then printed and distributed.

The final questionnaire contained 37 questions.

4.5 Mode of Distribution

The method of questionnaire distribution were as follows:

- Initial telephone interview with prospective participant companies (Section 4.2) wherein the project was explained and their participation was requested. These interviews helped OIR qualify respondents. Additionally, the contact person was asked to distribute other copies of the questionnaire at his/her company. If the contact person agreed to perform this task, they were considered a primary contact.

- The questionnaires were sent by Federal Express to each respondent company to guarantee next day delivery and high visibility. If contact was designated a primary contact, three copies (or more upon request) were sent to the respondent company.

- Twenty questionnaires were distributed to members of a professional society for electronics engineers at a monthly meeting. (Note: Rate of return was the lowest from this group.)

4.6 Questionnaire Distribution and Return

The majority of questionnaires were distributed to qualified respondents by December 10, 1981. Respondents were asked to return the questionnaires to OIR two weeks from the date of distribution.

OIR project team members continued to identify and qualify additional respondents and distribute the survey until December 20, 1981. OIR continued these activities in order to insure an adequate response to the survey to meet contract requirements.

Beginning December 15, 1981, OIR began follow-up telephone calls to those companies who had not returned their questionnaires within the requested two week period. Only eight responses had been received by December 20, 1981. The follow-up contacts were extremely successful and the required number of responses were received by January 7, 1982. Completed questionnaires (in excess of contract requirements) continued to be returned to OIR during February. All returned questionnaires were included in the final data analysis.

4.7 Survey Administration

A key element for survey administration was the reliance on the primary contact at each company, distributing the questionnaires, following up on tardy respondents, and insuring the return of the set of completed questionnaires to OIR. Therefore, the selection of the primary contact was a critical aspect of the initial telephone intereviews.

Each primary contact and all respondents subsequently received a letter from OIR (see Appendix A) and survey instruction (see Appendix B).

Section 5

SURVEY FINDINGS

The following sections provide the tabulated results of the returned questionnaire. Each subsection reports on separate analyses. The results are presented using the questionnaire format, for easy, question by question review.

Twenty-six companies responded to the survey, with a total of forty-nine individual questionnaires received.

Section 5.1 presents an overview chart of the tabulated results comparing the responses of different groups within the total population. This chart does not present every possible response to the questions in the interest of brevity.

Sections 5.2 - 5.6 present the detailed responses to the entire questionnaire by separate population groups within the sample.

- Section 5.2 Total Population
- Section 5.3 Electronic Product Design
- Section 5.4 Electronic Product Manufacturing
- Section 5.5 Electronic Product Testing
- Section 5.6 Electronic Product Manufacturing/Testing

In some questions, the total of the percentages is less than one hundred percent. This reflects non-responses to those questions. The questionnaire completion instructions encouraged participants to leave out questions which were beyond their own professional experience and expertise. Many respondents conscientiously exercised this option confirming information regarding specialization within electronics which OIR had previously received. Each area of electronics manufacture is extensive and requires the full time attention of engineers within that area. This specialization also reflects the constant evolving technology inherent to the electronics industry.

Each question presented the respondent with the option of "Other". OIR felt this would insure the identification of issues which were not covered by the questions in the survey. In the tabulated results,

- if there is no percentage figure after "Other", no respondent identified any additional information which should be captured by the ECACS.

- if a percentage figure follows "Other", that percentage of respondents felt additional information (more than identified by the question) should be captured by the ECACS.

- if additional information is delineated, OIR has consolidated respondent ideas and presented them whenever feasible.

- if an N/A appears after "Other", the percentage figure identifies the portion of the population who felt the question was not applicable to their experience.

5.1 SURVEY FINDINGS OVERVIEW

ECACS Summary Chart Questions & Findings	Total Sample Population	Electronic Product Design	Electronic Product Manufacturing	Electronic Product Testing	Electronic Product Mfg./Testing
	(49 responses)	(13 responses)	(18 responses)	(6 responses)	(7 responses)
Section 1					
1. N/A					
2. Your present position is primarily involved with:					
a. Electronic Product Design	27%	2%			
b. Electronic Product Manufacturing	46%		37%		
c. Electronic Product Testing	15%			11%	15%
3. In which of the following areas do you have experience?					
a. Methods Engineering	10%	8%	50%	20%	57%
b. Manufacturing Engineering	17%	31%	100%	60%	71%
c. Process Engineering	10%	8%	61%	-	57%
d. Design Engineering	16%	85%	67%	40%	14%
e. Test Engineering	12%	15%	28%	80%	100%
f. Development Engineering	13%	54%	44%	60%	14%
g. Research	6%	38%	17%	20%	-
h. Industrial Engineering	9%	15%	44%	-	43%
i. Product Support Engineering	6%	31%	33%	20%	29%
4. How many years of experience do you have in the electronics industry?					
a. Up to 5	7%	8%	6%	20%	-
b. 6 to 10	4%	8%	11%	-	-
c. 11 to 20	41%	31%	22%	60%	43%
d. More than 20	48%	53%	61%	20%	57%

5. In which areas of electronics design/manufacturing do you have direct experience?	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	Present Job	Previous Jobs	Present Job	Previous Jobs	Present Job	Previous Jobs	Present Job	Previous Jobs	Present Job	Previous Jobs
a. Packaging (panels, covers, chassis, etc.)	9%	10%	54%	54%	39%	28%	20%	20%	29%	43%
b. Wired Assemblies (cables, harnesses, point to point etc.)	13%	15%	62%	69%	67%	50%	60%	60%	57%	43%
c. Printed Wiring Boards	13%	12%	62%	77%	89%	50%	40%	40%	86%	57%
d. Discrete Components	9%	9%	38%	62%	39%	33%	-	20%	57%	57%
e. Integrated Circuits	10%	9%	62%	54%	50%	33%	20%	20%	57%	71%
f. Hybrid Microelectronics	8%	7%	38%	31%	50%	33%	20%	-	43%	57%
g. Wire Wound Magnetic Components	2%	5%	15%	15%	39%	56%	-	-	-	29%
h. Electronic Assemblies	13%	12%	54%	77%	78%	56%	60%	60%	100%	57%
i. Electro-Mechanical Assemblies	10%	9%	23%	31%	67%	50%	60%	40%	57%	43%
j. Electro-Optics	2%	5%	15%	31%	17%	39%	-	20%	14%	14%
k. Hardware	10%	7%	62%	62%	50%	39%	20%	20%	29%	29%

ECACS Summary Chart Questions & Findings	Total Sample Population (49 responses)	Electronic Product Design (13 responses)	Electronic Product Manufacturing (18 responses)	Electronic Product Testing (5 responses)	Electronic Product Mfg./Testing (7 responses)

6. The following summary details the percentage of companies with corresponding percentages for military and commercial products. For example, 22% of companies made only (100%) military products.

SUMMARY OF RESPONSES TO QUESTION #6:

Companies	Military	Companies	Commercial
17%	0	22%	0
11%	1 - 25%	34%	1 - 25%
5%	26 - 50%	11%	26 - 50%
11%	51 - 75%	5%	51 - 75%
17%	76 - 90%	0	76 - 90%
17%	91 - 99%	11%	91 - 99%
22%	100%	17%	100%

7. If you currently have in use a method for providing standardization in design or manufacturing, it is:

	Total Sample Population	Electronic Product Design	Electronic Product Manufacturing	Electronic Product Testing	Electronic Product Mfg./Testing
a. Formal And Automated	10%	92%	19%	20%	7%
b. Formal But Manual	45%	-	41%	10%	36%
c. Informal	25%	-	17%	40%	7%
d. None In Use	5%	-	6%	-	29%

8. In order to be useful, an EC & C should support your work in the following areas:

	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	Very Useful	Useful	Very Useful	Useful	Very Useful	Useful	Very Useful	Useful	Very Useful	Useful
a. Design Retrieval	52%	26%	69%	23%	61%	21%	40%	20%	14%	-
b. Process Documentation	54%	34%	15%	55%	61%	39%	20%	40%	29%	42%
c. Process Equipment Capacity Planning	32%	41%	-	15%	50%	33%	20%	20%	-	71%
d. New Processes/Designs	32%	41%	8%	38%	67%	28%	20%	40%	14%	14%
e. Cost Appraisal	48%	30%	47%	23%	50%	33%	40%	-	29%	43%
f. Design Standards	54%	25%	53%	31%	67%	22%	60%	-	29%	43%
g. Manufacturing Standards	48%	36%	31%	38%	67%	28%	60%	20%	43%	57%
h. Retrieval of Alternate Parts	44%	39%	31%	46%	28%	56%	40%	40%	42%	29%
i. Obsolescence Appraisal	19%	29%	-	23%	17%	39%	-	20%	29%	29%
j. Have Ease of Maintenance	64%	18%	15%	15%	56%	16%	20%	20%	29%	29%

9. In your view, what is an acceptable time to retrieve critical design or process information required to perform your function?

	Total Sample Population	Electronic Product Design	Electronic Product Manufacturing	Electronic Product Testing	Electronic Product Mfg./Testing
a. Seconds	23%	23%	11%	-	43%
b. Minutes	65%	46%	78%	60%	14%
c. Hours	8%	23%	11%	20%	29%
d. Days	4%	8%	-	20%	14%

ECACS Summary Chart Questions & Findings	Total Sample Population (49 responses)		Electronic Product Design (13 responses)		Electronic Product Manufacturing (18 responses)		Electronic Product Testing (5 responses)		Electronic Product Mfg./Testing (7 responses)	
10. If your company implements an EC & C system, which of the following advantages would be important to realize:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Increase Your Competitive Position	61%	30%	77%	15%	55%	17%	20%	40%	71%	29%
b. Increase Design Productivity	67%	33%	100%	-	55%	28%	80%	20%	29%	71%
c. Increase Manufacturing Productivity	88%	8%	77%	23%	94%	-	60%	20%	86%	14%
d. Lower Product Costs	92%	8%	77%	15%	67%	22%	60%	40%	71%	29%
e. Reduce Paperwork	58%	42%	69%	31%	67%	27%	40%	60%	29%	71%
f. Standardize Cost Evaluation Procedures	32%	68%	46%	46%	22%	67%	-	80%	14%	72%
g. Train Less Experienced Design/Mfg/ Test Engineers	14%	77%	15%	69%	22%	56%	-	60%	43%	43%
h. Identify Emerging/Advanced/Obsolete Processes and Materials	46%	50%	31%	61%	39%	50%	40%	40%	29%	57%
i. Shorten Elapsed Time Between Design And Production	79%	21%	84%	8%	83%	11%	80%	-	71%	29%
j. Utilize Knowledge & Experience of Existing Designs & Processes	71%	25%	62%	38%	78%	11%	60%	40%	72%	14%
k. Inventory Reduction	43%	48%	-	77%	33%	50%	40%	20%	58%	14%
l. Facilitate Automation of Manufacturing & Test Operations	61%	35%	38%	46%	61%	28%	60%	20%	57%	43%
11. In order to be valuable, an EC & C should use:										
a. Industry Wide Normalized Data		12%		8%		28%		-		14%
b. Data Specific To Your Company		15%		46%		22%		-		43%
c. Both		73%		38%		50%		100%		43%
12. How familiar are you with the concept of Group Technology?										
a. Work Or Have Worked With It		12%		-		17%		20%		-
b. Familiar But Have Not Used It		46%		38%		56%		20%		57%
c. Not Familiar With Group Technology		42%		62%		28%		60%		43%
13. Rate the significance of each of the following as a major electronic family grouping:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Packaging (panels, covers, chassis, etc.)	61%	35%	62%	15%	50%	33%	-	80%	43%	43%
b. Wired Assemblies (cables, harnesses, point to point)	65%	31%	62%	15%	44%	39%	-	100%	71%	29%
c. Printed Wiring Boards	84%	12%	70%	-	67%	33%	60%	40%	86%	14%
d. Discrete Components	61%	35%	31%	54%	55%	39%	80%	-	43%	43%
e. Integrated Circuits	67%	29%	47%	38%	66%	28%	80%	-	57%	41%
f. Hybrid Microelectronics	52%	44%	46%	31%	44%	50%	60%	20%	57%	29%
g. Wire Wound Magnetic Components	31%	52%	15%	54%	39%	44%	40%	20%	14%	43%
h. Electronic Assemblies	77%	19%	67%	30%	83%	17%	100%	-	86%	14%
i. Electro-Magnetic Assemblies	48%	41%	23%	62%	44%	44%	40%	20%	43%	43%
j. Electro-Optics	41%	36%	8%	61%	33%	39%	20%	40%	29%	14%
k. Hardware	43%	52%	38%	47%	44%	28%	20%	60%	14%	58%

ECACS Summary Chart Questions & Findings	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	(49 responses)		(13 responses)		(18 responses)		(5 responses)		(7 responses)	
Section 2										
A. PACKAGING										
1. Rate the following characteristics as to whether they should be considered in developing an EC & C.	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Shape	60%	40%	31%	31%	33%	39%	60%	-	29%	43%
b. Shape Elements (holes, slots, etc.)	52%	43%	31%	38%	28%	44%	20%	40%	43%	29%
c. Position of Shape Elements	59%	35%	38%	31%	33%	39%	-	60%	14%	58%
d. Number of Various Shape Elements (quantity)	55%	40%	23%	39%	28%	44%	40%	20%	57%	29%
e. Dimensions	72%	28%	62%	15%	39%	33%	40%	40%	57%	29%
f. Tolerances	57%	38%	54%	23%	55%	17%	20%	40%	43%	43%
g. Material	60%	25%	38%	39%	55%	17%	40%	20%	58%	14%
h. Major Machining Operations	30%	55%	8%	54%	33%	33%	40%	20%	58%	14%
i. Major Fabrication Operations	53%	33%	23%	39%	50%	22%	20%	40%	43%	29%
j. Surface Treatments	29%	60%	8%	54%	28%	44%	-	60%	57%	29%
k. Lot Size (quantity/time unit)	28%	55%	15%	47%	28%	33%	40%	40%	-	71%
l. End Use of Package (internal, external)	20%	40%	31%	23%	11%	28%	-	60%	14%	58%
2. What testing and evaluation processes which apply to the packaging category should be considered by an EC & C?										
a. Dimensional Analysis	88%		69%		61%		80%		86%	
b. Metallurgical/Material Evaluation	67%		31%		33%		20%		29%	
c. Stress/Strength Analysis	83%		69%		56%		40%		43%	
d. Color, Texture (Aesthetic Evaluation)	100%		8%		28%		20%		14%	
e. Static Dissipation	86%		38%		56%		20%		29%	
f. EMI Shielding	86%		85%		72%		40%		29%	
B. WIRED ASSEMBLIES										
1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C.	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Number of Conductors	84%	16%	69%	23%	71%	6%	60%	40%	71%	29%
b. Size of Conductors	75%	25%	69%	23%	72%	11%	40%	60%	86%	14%
c. Type of End Terminations	83%	13%	61%	31%	72%	11%	60%	20%	100%	-
d. Type of Insulation	58%	42%	54%	31%	28%	55%	80%	20%	86%	14%
e. Type of Base Material	36%	59%	31%	54%	22%	55%	20%	40%	29%	71%
f. Type of Surface Plating	29%	62%	39%	46%	28%	44%	20%	60%	14%	72%
g. Voltage/Current/Frequency Data	48%	39%	61%	31%	44%	23%	80%	20%	29%	57%
h. Shielding	70%	30%	70%	15%	55%	28%	80%	20%	71%	29%

ECACS Summary Chart Questions & Findings	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	(49 responses)		(13 responses)		(18 responses)		(5 responses)		(7 responses)	
i. Dimensions	78%	22%	77%	15%	71%	6%	40%	40%	86%	-
j. Number of Branches	60%	36%	39%	46%	50%	22%	60%	20%	29%	71%
k. Type (e.g. Flat, Ribbon, Coax)	78%	13%	85%	-	71%	6%	40%	40%	72%	-
l. Lot Size (Quantity/Time Unit)	33%	43%	15%	55%	28%	33%	40%	40%	14%	43%
m. End Product Destination	18%	45%	8%	54%	6%	50%	-	40%	14%	57%
n. Machine Operations	32%	55%	15%	55%	27%	50%	-	60%	42%	29%
o. Manual Operations	37%	58%	15%	55%	22%	55%	20%	60%	29%	43%
p. Lot Size (Quantity/Time Unit)	40%	47%	8%	54%	28%	28%	-	60%	14%	43%
q. Coating/Encapsulation	32%	61%	31%	46%	28%	44%	-	80%	29%	57%
r. Joining Processes	45%	50%	31%	39%	44%	34%	20%	40%	43%	43%
2. What testing and evaluation processes should be considered by an EC & C:										
a. Dimensional		64%		69%		61%		60%		71%
b. Opens/Shorts Testing		88%		92%		78%		100%		100%
c. Impedence Testing		52%		69%		33%		60%		71%
d. Hi-Pot Testing		64%		69%		50%		80%		86%
e. Insulation Characteristics		44%		54%		50%		60%		29%
f. Mechanical		36%		38%		56%		60%		43%
g. Joining Processes		44%		31%		39%		80%		14%
C. PRINTED WIRING BOARDS (PWB)										
1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Shape	55%	45%	46%	31%	55%	33%	40%	20%	43%	43%
b. Dimensions	71%	25%	54%	31%	66%	28%	60%	-	86%	-
c. Lot Size (Quantity/Time Unit)	35%	35%	8%	54%	33%	22%	-	60%	14%	58%
d. Tolerances	48%	39%	54%	23%	60%	28%	20%	40%	72%	14%
e. Type of Base Material	41%	52%	39%	46%	55%	28%	-	60%	72%	14%
f. Type of Conductive Material	41%	59%	46%	31%	60%	28%	-	60%	43%	29%
g. Conductor Electrical Characteristics	14%	72%	54%	23%	28%	60%	40%	20%	-	86%
h. Environment Requirements	41%	41%	39%	46%	44%	33%	40%	20%	43%	43%
i. Printed Circuitry Processes	36%	50%	15%	55%	39%	44%	40%	20%	29%	43%
j. Hole Information (Size, Quantity, etc.)	59%	32%	54%	31%	83%	11%	20%	40%	72%	14%
k. Number of Layers	73%	27%	70%	15%	83%	11%	60%	-	72%	14%
l. Types of Layers	52%	38%	70%	15%	44%	44%	60%	-	72%	14%
m. Plating Information	32%	64%	46%	31%	44%	50%	-	60%	29%	57%
n. Masking & Coating	50%	50%	39%	38%	61%	22%	-	60%	43%	43%

ECACS Summary Chart Questions & Findings	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	(49 responses)		(13 responses)		(18 responses)		(5 responses)		(7 responses)	
2. What testing and evaluation processes should be considered by an EC & C:										
a. Bond Evaluation (Layer)	64%		38%		50%		40%		43%	
b. Bond Evaluation (Conductor)	59%		31%		56%		40%		43%	
c. Metallurgical Evaluation of Plating Quality	59%		31%		61%		40%		71%	
d. Impedence	32%		38%		28%		40%		-	
e. Dimensional	77%		54%		78%		60%		86%	
f. Electrical Testing	77%		54%		78%		60%		86%	
g. Micro Sectioning	50%		31%		44%		40%		43%	
D. DISCRETE COMPONENT										
1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Type of Package	84%	16%	70%	15%	78%	-	60%	-	72%	14%
b. Lead Configuration	80%	20%	77%	8%	78%	-	60%	20%	72%	14%
c. Package Dimension	79%	21%	77%	8%	67%	11%	60%	-	72%	14%
d. Parametric Specs	55%	35%	39%	38%	39%	33%	80%	-	14%	58%
e. Environmental Specs	42%	47%	39%	46%	39%	33%	40%	20%	14%	72%
f. Adjustability	17%	72%	8%	62%	22%	45%	20%	40%	14%	58%
g. Component Type	74%	26%	62%	23%	66%	6%	40%	20%	72%	14%
h. Lot Size (Quantity/Time Unit)	37%	31.5%	15%	55%	22%	22%	-	60%	14%	58%
2. What test and evaluation processes should be considered by an EC & C:										
a. Parametric	74%		54%		61%		60%		71%	
b. Functional	89%		62%		78%		60%		86%	
c. Chemical/ Metallurgical Analysis (Leads and Package)	37%		15%		44%		40%		14%	
d. Microsectioning	11%		-		6%		20%		-	
e. Dimensional	63%		54%		50%		60%		71%	
f. Environmental	47%		31%		44%		60%		57%	
E. INTEGRATED CIRCUITS										
1. Rate the significance of the following characteristics as to whether they should be considered a variable in relation to an EC & C.	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Type Of Packaging	94%	6%	77%	8%	77%	6%	60%	-	86%	-
b. Lead Arrangements	89%	11%	85%	-	77%	6%	60%	-	86%	-
c. Number Of Leads	89%	11%	85%	-	72%	11%	60%	-	57%	29%
d. Type By Function	58%	42%	77%	8%	33%	50%	60%	20%	86%	-
e. Scale Of Integration, (LSI, SSI, etc).	22%	56%	31%	46%	28%	38%	20%	40%	14%	58%

ECACS Summary Chart Questions & Findings	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	(49 responses)		(13 responses)		(18 responses)		(5 responses)		(7 responses)	
f. Overall Package Dimensions	56%	44%	70%	15%	56%	27%	60%	-	43%	43%
g. Circuit Performance	47%	37%	62%	23%	50%	22%	60%	20%	29%	57%
h. Environmental Requirements	56%	28%	46%	39%	33%	44%	40%	20%	43%	43%
i. Lot Size (Quantity/Time Unit)	41%	24%	15%	47%	22%	28%	-	60%	29%	29%
2. What test and evaluation processes should be considered by an EC & C:										
a. Fine/Gross Leak Test	26%		38%		44%		-		29%	
b. Parametric Testing	58%		46%		56%		60%		71%	
c. Functional Testing	63%		69%		78%		60%		71%	
d. Pattern Sensitivity Testing	37%		31%		33%		40%		43%	
e. Temperature	42%		62%		56%		60%		57%	
f. Burn-In	68%		38%		72%		80%		86%	
g. Dynamic	47%		31%		72%		60%		43%	
h. Static	47%		23%		50%		60%		57%	
i. Product Application	21%		23%		28%		40%		29%	
j. Temperature Cycling	37%		46%		67%		60%		43%	
F. HYBRID MICRO ELECTRONICS										
1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Type of Packaging	93%	7%	69%	8%	66%	6%	40%	20%	86%	-
b. Lead Arrangement	81%	19%	77%	-	66%	6%	60%	-	72%	14%
c. Number of Leads	88%	12%	77%	-	55%	17%	40%	20%	57%	29%
d. Internal Circuit Types	31%	64%	61%	8%	11%	50%	20%	40%	29%	57%
e. Number of Internal Elements	22%	67%	38%	31%	11%	55%	20%	20%	43%	43%
f. Package Dimensions	75%	25%	62%	15%	61%	11%	40%	20%	72%	14%
g. Lead Related Dimensions	56%	44%	54%	23%	55%	17%	20%	40%	72%	14%
h. Circuit Parametric Specs	41%	53%	46%	31%	33%	33%	40%	20%	43%	43%
i. Lot Size (Quantity)	35%	30%	15%	39%	17%	22%	-	60%	29%	29%
j. Environmental Specs	50%	17%	38%	39%	33%	33%	40%	20%	57%	29%
2. What test and evaluation processes should be considered by an EC & C:										
a. Physical Characteristics	78%		38%		67%		60%		71%	
b. Parametrics	83%		46%		61%		60%		71%	
c. Functional Testing	94%		62%		72%		60%		100%	
d. Static Testing	56%		46%		44%		60%		29%	
e. Microsectioning	11%		-		22%		20%		-	
f. Pattern Sensitivity	17%		38%		28%		40%		29%	

ECACS Summary Chart Questions & Findings	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	(49 responses)		(13 responses)		(18 responses)		(5 responses)		(7 responses)	
G. WIRE WOUND MAGNETIC COMPONENTS										
1. Rate the following characteristics as to whether they should be considered by an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Shape	79%	21%	69%	-	72%	6%	20%	-	29%	28%
b. Function	88%	12%	62%	7%	56%	22%	60%	-	43%	28%
c. Dimensions	86%	14%	69%	-	72%	6%	60%	-	43%	28%
d. Electrical Data	69%	31%	62%	7%	56%	22%	60%	-	28%	43%
e. Winding Wire Data	60%	40%	46%	15%	44%	34%	40%	20%	29%	14%
f. Lamination Data	40%	53%	15%	38%	28%	50%	20%	40%	29%	14%
g. Adjustability	21%	64%	23%	38%	22%	45%	20%	20%	-	43%
h. Type of Shielding/Sleeving	44%	50%	38%	31%	39%	39%	20%	40%	14%	57%
i. External Lead Data	79%	21%	53%	8%	72%	6%	40%	-	14%	29%
j. Machine Processes	27%	53%	-	31%	17%	50%	-	20%	29%	28%
k. Major Fabrication Operations	33%	47%	-	31%	28%	39%	-	20%	14%	43%
l. Coating/Encapsulation	35%	41%	23%	46%	61%	17%	-	60%	-	29%
m. Lot Size (Quantity/Time Unit)	42%	42%	8%	31%	17%	22%	-	20%	14%	29%
2. What test and evaluation processes should b considered by an EC & C:										
a. Induction	76%		54%		78%		60%		71%	
b. Impedence	76%		54%		72%		60%		71%	
c. Coupling	65%		46%		67%		60%		43%	
d. Load Effects	59%		54%		67%		60%		14%	
e. Excitation Current	53%		46%		56%		40%		14%	
f. Permeability	41%		46%		39%		40%		14%	
g. Voltage/Current/Frequency Data	58%		62%		72%		60%		43%	
h. Hi-Pot	65%		46%		72%		40%		57%	
i. Dimensions	53%		46%		72%		20%		29%	
j. Resistance	53%		46%		56%		40%		29%	
H. ELECTRONIC ASSEMBLIES (EA)										
1. Rate the following characteristics as to whether they should be considered by an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Shape	68%	32%	47%	15%	56%	22%	40%	20%	72%	-
b. Function	86%	14%	54%	15%	50%	22%	100%	-	86%	14%
c. Tolerances	58%	37%	61%	8%	50%	28%	40%	20%	57%	29%
d. Type of Composite Components	47%	47%	46%	23%	33%	39%	20%	60%	29%	43%
e. Number of Composite Components	53%	37%	38%	31%	39%	33%	20%	60%	43%	29%
f. Lot Size (Quantity/Time Unit)	26%	48%	15%	39%	28%	17%	-	80%	14%	58%
g. Major Fabrication Operations	55%	30%	-	54%	44%	34%	40%	20%	72%	14%
h. Component Spacing Information	42%	47%	46%	23%	44%	34%	-	80%	29%	57%
i. Special Packaging	63%	32%	46%	31%	61%	17%	20%	60%	43%	43%

ECACS Summary Chart Questions & Findings	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	(49 responses)		(13 responses)		(18 responses)		(5 responses)		(7 responses)	
j. Electrical Performance Specs	58%	37%	39%	38%	44%	34%	80%	-	57%	29%
k. Special Environmental Requirements	58%	32%	39%	38%	44%	28%	60%	20%	57%	29%
l. Coating/Encapsulation	44%	47%	15%	62%	39%	28%	-	80%	43%	43%
2. What test and evaluation processes should be considered by an EC & C:										
a. Functional Testing	90%		69%		72%		100%		100%	
b. In Circuit Testing	90%		62%		67%		100%		100%	
c. Parametrics	43%		46%		44%		40%		29%	
d. Dynamic Testing	52%		54%		67%		60%		29%	
e. In-Product Substitution	29%		46%		22%		20%		14%	
f. Environmental Chamber	41%		54%		44%		60%		57%	
I. ELECTRO-MECHANICAL ASSEMBLIES										
1. Rate the following characteristics as to whether they should be considered by an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Shape	79%	21%	54%	15%	55%	17%	40%	20%	72%	14%
b. Functions(s)	85%	15%	46%	23%	50%	16%	80%	-	57%	43%
c. Dimensions	94%	3%	69%	-	72%	-	80%	-	72%	14%
d. Lotsize (Quantity/Time Unit)	22%	56%	8%	46%	22%	22%	-	80%	14%	58%
e. Type of Electronic Components	39%	56%	31%	38%	50%	22%	40%	40%	57%	43%
f. Quantity of Electronic Components	60%	30%	47%	15%	39%	33%	-	80%	57%	43%
g. Type of Mechanical Components	53%	37%	38%	31%	50%	22%	60%	20%	43%	43%
h. Quantity of Mechanical Components	55%	25%	54%	8%	44%	28%	-	80%	43%	57%
i. Type of Electro-Optical Components	53%	37%	31%	23%	44%	28%	60%	20%	29%	43%
j. Quantity of Electro-Optical Components	45%	35%	39%	15%	33%	39%	-	80%	29%	43%
k. Major Machining Operations	55%	25%	8%	54%	44%	28%	40%	20%	58%	14%
l. Major Assembly Operations	61%	22%	8%	54%	55%	17%	40%	20%	86%	14%
m. Coating/Encapsulation	25%	55%	15%	39%	28%	39%	20%	40%	29%	57%
n. Joining Processes	40%	40%	15%	47%	39%	33%	40%	20%	71%	29%
2. What test and evaluation processes should be considered by an EC & C?										
a. Functional Testing	26%		69%		61%		80%		86%	
b. Parametrics	17%		46%		39%		40%		43%	
c. Point To Point Internal Interconnections	17%		54%		56%		60%		43%	
d. Dynamic	9%		54%		50%		80%		43%	
e. In-Product Substitution	9%		46%		22%		40%		-	

ECACS Summary Chart Questions & Findings	Total Sample Population		Electronic Product Design		Electronic Product Manufacturing		Electronic Product Testing		Electronic Product Mfg./Testing	
	(49 responses)		(13 responses)		(18 responses)		(5 responses)		(7 responses)	
J. ELECTRO-OPTICS										
1. Rate the following characteristics as to whether they should be considered by an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Type of Packaging	50%	50%	46%	15%	56%	11%	40%	-	29%	14%
b. Lead Configuration	75%	25%	54%	-	67%	-	20%	20%	43%	-
c. Coupling Techniques	33%	67%	46%	15%	44%	23%	40%	-	29%	14%
d. Dimensions	33%	67%	61%	-	61%	6%	20%	20%	14%	29%
e. Performance	67%	33%	53%	8%	56%	11%	40%	-	14%	29%
f. Lot Size (Quantity/Time)	25%	-	8%	38%	11%	22%	-	40%	14%	29%
2. What test and evaluation processes should be considered by an EC & C:										
a. Dimensional	50%		38%		50%		20%		29%	
b. Signal Transmission	50%		46%		56%		40%		43%	
c. Parametrics	25%		38%		33%		40%		14%	
K. HARDWARE										
1. Rate the following characteristics as to whether they should be considered by an EC & C:	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
a. Type of Hardware	86%	10%	62%	-	61%	6%	40%	20%	86%	14%
b. Shape	74%	21%	54%	23%	56%	11%	20%	40%	72%	14%
c. Mounting Technique	63%	21%	61%	8%	50%	17%	20%	40%	72%	14%
d. Dimensions	70%	20%	69%	8%	56%	11%	20%	40%	57%	29%
e. Base Material	22%	67%	46%	31%	17%	50%	-	40%	14%	43%
f. Surface Treatment	16%	58%	23%	39%	23%	44%	-	40%	-	72%
g. Machining Operations	44%	39%	8%	38%	28%	39%	-	40%	43%	29%
h. Fabrication Operations	48%	33%	8%	38%	33%	33%	-	40%	57%	29%
i. Lot Size (Quantity/Time Unit)	37%	37%	15%	31%	22%	17%	-	60%	29%	29%
j. Custom or Standard	58%	33%	46%	23%	33%	33%	20%	40%	29%	43%
2. What test and evaluation processes should be considered by an EC & C:										
a. Dimensional	76%		62%		61%		60%		86%	
b. Metalurgical/Material	24%		38%		17%		40%		14%	
c. Aesthetics	29%		31%		33%		60%		43%	
d. Plating Analysis	33%		23%		44%		20%		14%	

5.2 TOTAL SAMPLE POPULATION

(49 responses)

ELECTRONICS CLASSIFICATION AND CODING SYSTEM SURVEY

Section 1

1. Name_____
   Company_____
   Position_____

2. Your present position is primarily invovlved with:
   27% a. Electronic Product Design
   46% b. Electronic Product Manufacturing
   15% c. Electronic Product Testing
   12% d. Other_____

3. In which of the following areas do you have experience?
   10% a. Methods Engineering
   17% b. Manufacturing Engineering
   10% c. Process Engineering
   16% d. Design Engineering
   12% e. Test Engineering
   13% f. Development Engineering
   6% g. Research
   9% h. Industrial Engineering
   6% i. Product Support Engineering
   1% j. Other_____

4. How many years of experience do you have in the electronics industry?
   7% a. Up to 5
   4% b. 6 to 10
   41% c. 11 to 20
   48% d. More than 20

5. In which areas of electronics design/manufacturing do you have direct experience? (Check all that apply).

Present Job	Previous Jobs		
9%	10%	a.	Packaging (panels, covers, chassis, etc.)
13%	15%	b.	Wired Assemblies (cables, harnesses, point to point etc.)
13%	12%	c.	Printed Wiring Boards
9%	9%	d.	Discrete Components
10%	9%	e.	Integrated Circuits
8%	7%	f.	Hybrid Microelectronics
2%	5%	g.	Wire Wound Magnetic Components
13%	12%	h.	Electronic Assemblies
10%	9%	i.	Electro-Mechanical Assemblies
2%	5%	j.	Electro-Optics
10%	7%	k.	Hardware
1%	-	l.	Other_____

6. The following summary details the percentage of companies with corresponding percentages for military and commercial products. For example, 22% of companies made only (100%) military products.

SUMMARY OF RESPONSES TO QUESTION #6:

Companies	Military	Companies	Commercial
17%	0	22%	0
11%	1 - 25%	34%	1 - 25%
5%	26 - 50%	11%	26 - 50%
11%	51 - 75%	5%	51 - 75%
17%	76 - 90%	0	76 - 90%
17%	91 - 99%	11%	91 - 99%
22%	100%	17%	100%

7. If you currently have in use a method for providing standardization in design or manufacturing, it is:

10%	a.	Formal And Automated
45%	b.	Formal But Manual
25%	c.	Informal
5%	d.	None In Use
15%	e.	Other _____

8. In order to be useful, an EC & C should support your work in the following areas:

	Very Useful	Useful	Somewhat Useful	Not Useful
a. Design Retrieval	52%	26%	13%	9%
b. Process Documentation	54%	34%	8%	4%
c. Process Equipment Capacity Planning	32%	41%	13.5%	13.5%
d. New Processes/Designs	32%	41%	23%	4%
e. Cost Appraisal	48%	30%	22%	-
f. Design Standards	54%	25%	21%	-
g. Manufacturing Standards	48%	36%	12%	4%
h. Retrieval of Alternate Parts	44%	39%	13%	4%
i. Obsolescence Appraisal	19%	29%	52%	-
j. Have Ease of Maintenance	64%	18%	4%	14%

9. In your view, what is an acceptable time to retrieve critical design or process information required to perform your function?

23%	a.	Seconds
65%	b.	Minutes
8%	c.	Hours
4%	d.	Days

10. If your company implements an EC & C system, which of the following advantages would be important to realize:

	Primary	Secondary	Not Important
a. Increase Your Competitive Position	61%	30%	9%
b. Increase Design Productivity	67%	33%	-
c. Increase Manufacturing Productivity	88%	8%	4%
d, Lower Product Costs	92%	8%	-
e. Reduce Paperwork	58%	42%	-
f. Standardize Cost Evaluation Procedures	32%	68%	-
g. Train Less Experienced Design/Mfg/ Test Engineers	14%	77%	9%
h. Identify Emerging/Advanced/Obsolete Processes and Materials	46%	50%	4%
i. Shorten Elapsed Time Between Design And Production	79%	21%	-
j. Utilize Knowledge & Experience of Existing Designs & Processes	71%	25%	4%
k. Inventory Reduction	43%	48%	9%
l. Facilitate Automation of Mfg & Test Operations	61%	35%	4%

11. In order to be valuable, an EC & C should use:

12% a. Industry Wide Normalized Data
15% b. Data Specific To Your Company
73% c. Both

12. How familiar are you with the concept of Group Technology?

12% a. Work Or Have Worked With It
46% b. Familiar But Have Not Used It
42% c. Not Familiar With Group Technology

13. Rate the significance of each of the following as a major electronic family grouping:

	Primary	Secondary	Not Important
a. Packaging (panels, covers, chassis, etc.)	61%	35%	4%
b. Wired Assemblies (cables, harnesses, point to point)	65%	31%	4%
c. Printed Wiring Boards	84%	12%	4%
d. Discrete Components	61%	35%	4%
e. Integrated Circuits	67%	29%	4%
f. Hybrid Microelectronics	52%	44%	4%
g. Wire Wound Magnetic Components	31%	52%	17%
h. Electronic Assemblies	77%	19%	4%
i. Electro-Magnetic Assemblies	48%	43%	9%
j. Electro-Optics	41%	36%	23%
k. Hardware	43%	52%	5%
l. Other _____	____	____	____

Section 2

A. PACKAGING

DEFINITION: Packaging encompasses the elements (components/assemblies) which are required to create a "black box" which will contain electronic components, (i.e. panels, covers, chassis, etc.).

1. Rate the following characteristics as to whether they should be considered in developing an EC & C.

	Primary	Secondary	Not Important
a. Shape	60%	40%	-
b. Shape Elements (holes, slots, etc.)	52%	43%	5%
c. Position of Shape Elements	59%	35%	6%
d. Number of Various Shape Elements (quantity)	55%	40%	5%
e. Dimensions	72%	28%	-
f. Tolerances	57%	38%	5%
g. Material	60%	25%	15%
h. Major Machining Operations	30%	55%	15%
i. Major Fabrication Operations	53%	33%	14%
j. Surface Treatments	29%	60%	11%
k. Lot Size (quantity/time unit)	28%	55%	17%
l. End Use of Package (internal, external)	20%	40%	40%
M. Others _____	____	____	____

2. What testing and evaluation processes which apply to the packaging category should be considered by an EC & C?

Check all that are applicable.

- 88% a. Dimensional Analysis
- 67% b. Metallurgical/Material Evaluation
- 83% c. Stress/Strength Analysis
- 100% d. Color, Texture (Aesthetic Evaluation)
- 86% e. Static Dissipation
- 86% f. EMI Shielding
- - g. Other _____

B. WIRED ASSEMBLIES

Definition: An assembly consisting of multiconductor grouping of wires, point to point wiring, etched/additive wire assemblies, and/or flexible printed cables.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important
a. Number of Conductors	84%	16%	-
b. Size of Conductors	75%	25%	-
c. Type of End Terminations	83%	13%	4%
d. Type of Insulation	58%	42%	-
e. Type of Base Material	36%	59%	5%
f. Type of Surface Plating	29%	62%	9%
g. Voltage/Current/Frequency Data	48%	39%	13%
h. Shielding	70%	30%	-
i. Dimensions	78%	22%	-
j. Number of Branches	60%	36%	4%
k. Type (e.g. Flat, Ribbon, Coax)	78%	13%	9%
l. Lot Size (Quantity/Time Unit)	33%	43%	24%
m. End Product Destination	18%	45%	37%
n. Machine Operations	32%	55%	13%
o. Manual Operations	37%	58%	5%
p. Lot Size (Quantity/Time Unit)	40%	47%	13%
q. Coating/Encapsulation	32%	63%	5%
r. Joining Processes	45%	50%	5%
s. Other _____	____	____	____

Wired Assemblies - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check all which apply

64%	a. Dimensional
88%	b. Opens/Shorts Testing
52%	c. Impedence Testing
64%	d. Hi-Pot Testing
44%	e. Insulation Characteristics
36%	f. Mechanical
44%	g. Joining Processes
-	h. Other_____

C. PRINTED WIRING BOARDS (PWB)

Definition: A completely processed conductor pattern(s) all formed on a common base.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C:

	Primary	Secondary	Not Important
a. Shape	55%	45%	-
b. Dimensions	71%	25%	4%
c. Lot Size (Quantity/Time Unit)	35%	35%	30%
d. Tolerances	48%	39%	13%
e. Type of Base Material	43%	52%	5%
f. Type of Conductive Material	41%	59%	-
g. Conductor Electrical Characteristics	14%	72%	14%
h. Environment Requirements	41%	41%	18%
i. Printed Circuitry Processes	36%	50%	14%
j. Hole Information (Size, Quantity, etc.)	59%	32%	9%
k. Number of Layers	73%	27%	-
l. Types of Layers	52%	38%	10%
m. Plating Information	32%	64%	4%
n. Masking & Coating	50%	50%	-
o. Other _____	____	____	____

PWB - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check as apply

64% a. Bond Evaluation (Layer)
59% b. Bond Evaluation (Conductor)
59% c. Metallurgical Evaluation of Plating Quality
32% d. Impedence
77% e. Dimensional
77% f. Electrical Testing
50% g. Micro Sectioning
___ h. Other _____

D. DISCRETE COMPONENT

Definition: Any passive or active electronic component, other than integrated circuits and hybrid microelectronics. (e.g. capacitors, resistors, switches, diodes, transistors, etc.)

1. Rate the significance of th following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Type of Package	84%	16%	-
b. Lead Configuration	80%	20%	-
c. Package Dimension	79%	21%	-
d. Parametric Specs	55%	35%	10%

	Primary	Secondary	Not Important
e. Environmental Specs	42%	47%	11%
f. Adjustability	17%	72%	11%
g. Component Type	74%	26%	-
h. Lot Size (Quantity/Time Unit)	37%	31.5%	31.5%
i. Other _____			

2. What test and evaluation processes should be considered by an EC & C:

Check all that apply

74% a. Parametric
89% b. Functional
37% c. Chemical/ Metallurgical Analysis (Leads and Package)
11% d. Microsectioning
63% e. Dimensional
47% f. Environmental
____ g. Other

E. INTEGRATED CIRCUITS

Definition: A complex electronic semiconductor circuit, packaged as an individual component.

1. Rate the significance of the following charactristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important
a. Type Of Packaging	94%	6%	-
b. Lead Arrangements	89%	11%	-
c. Number Of Leads	89%	11%	-
d. Type By Function	58%	42%	-
e. Scale Of Integration, (LSI, SSI, etc).	22%	56%	22%
f. Overall Package Dimensions	56%	44%	-
g. Circuit Performance	47%	37%	16%
h. Environmental Requirements	56%	28%	16%
i. Lot Size (Quantity/Time Unit)	41%	24%	35%
j. Other _____			

Integrated Circuits - Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C?

Check all which apply:

26% a. Fine/Gross Leak Test
58% b. Parametric Testing
63% c. Functional Testing
37% d. Pattern Sensitivity Testing
42% e. Temperature
68% f. Burn-In
47% g. Dynamic

h. 47% Static
i. 21% Product Application
j. 37% Temperature Cycling
k. - Other _____

F. HYBRID MICRO ELECTRONICS

Definition: A packaging technique that intrconnects passive and/or semiconductor devices within a single package.

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C.

	Primary	Secondary	Not Important
a. Type of Packaging	93%	7%	-
b. Lead Arrangement	81%	19%	-
c. Number of Leads	88%	12%	-
d. Internal Circuit Types	31%	64%	5%
e. Number of Internal Elements	22%	67%	11%
f. Package Dimensions	75%	25%	-
g. Lead Related Dimensions	56%	44%	-
h. Circuit Parametric Specs	41%	53%	6%
i. Lot Size (Quantity)	35%	30%	35%
j. Environmental Specs	50%	37%	13%
k. Other _____			

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C.

Check all that apply

78% a. Physical Characteristics
83% b. Parametrics
94% c. Functional Testing
56% e. Static Testing
11% f. Microsectioning
17% g. Pattern Sensitivity
39% .h. Other _____

G. WIRE WOUND MAGNETIC COMPONENTS

Definition: Any device which acts or reacts due to the electromagnetic field induced by current flowing through wire windings. This shall include transformers, actuators, rotary components and coils.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Shape	79%	21%	-
b. Function	88%	12%	-
c. Dimensions	86%	14%	-

	Primary	Secondary	Not Important
d. Electrical Data	69%	31%	-
e. Winding Wire Data	60%	40%	-
f. Lamination Data	40%	53%	7%
g. Adjustability	21%	64%	15%
h. Type of Shielding/Sleeving	44%	50%	6%
i. External Lead Data	79%	21%	-
j. Machine Processes	27%	53%	20%
k. Major Fabrication Operations	33%	47%	30%
l. Coating/Encapsulation	35%	41%	24%
m. Lot Size (Quantity/Time Unit)	42%	42%	16%
n. Other _____	____	____	____

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C:

Check all which apply:

76%	a. Induction
76%	b. Impedence
65%	c. Coupling
59%	d. Load Effects
53%	e. Excitation Current
41%	f. Permeability
58%	g. Voltage/Current/Frequency Data
65%	h. Hi-Pot
53%	i. Dimensions
53%	j. Resistance
____	k. Other _____

H. ELECTRONIC ASSEMBLIES (EA)

Definition: A final assembly or second level assembly which includes a printed circuit board. These shall contain electronic, mechanical, and/or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Shape	68%	32%	-
b. Function	86%	14%	-
c. Tolerances	58%	37%	5%
d. Type of Composite Components	47%	47%	6%
e. Number of Composite Components	53%	37%	10%
f. Lot Size (Quantity/Time Unit)	26%	48%	26%
g. Major Fabrication Operations	55%	30%	15%
h. Component Spacing Information	42%	47%	11%
i. Special Packaging	63%	32%	5%
j. Electrical Performance Specs	58%	37%	5%

	Primary	Secondary	Not Important
k. Special Environmental Requirements	58%	32%	10%
l. Coating/Encapsulation	44%	47%	12%
m. Other _____	____	50%	50%

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

90% a. Functional Testing
90% b. In Circuit Testing
43% c. Parametrics
52% d. Dynamic Testing
29% e. In-Product Substitution
43% f. Environmental Chamber
____ g. Other _____

I. ELECTRO-MECHANICAL ASSEMBLIES

Definition: A final or secondary level assembly which performs an electronic function, but is manufactured using basically mechanical operations such as staking, riviting, screws, bolting and hard mounting of electronic or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Shape	79%	21%	-
b. Functions(s)	85%	15%	-
c. Dimensions	94%	3%	3%
d. Lotsize (Quantity/Time Unit)	22%	56%	22%
e. Type of Electronic Components	39%	56%	5%
f. Quantity of Electronic Components	60%	30%	10%
g. Type of Mechanical Components	53%	37%	10%
h. Quantity of Mechanical Components	55%	25%	20%
i. Type of Electro-Optical Components	53%	37%	10%
j. Quantity of Electro-Optical Components	45%	35%	20%
k. Major Machining Operations	55%	25%	20%
l. Major Assembly Operations	61%	22%	17%
m. Coating/Encapsulation	25%	55%	20%
n. Joining Processes	40%	40%	20%
o. Other_____	____	____	____

Test Evaluation

2. What test and evaluation processes should be considerd by EC & C:

26% a. Functional Testing
17% b. Parametrics
17% c. Point To Point Internal Interconnections
9% d. Dynamic
9% e. In-Product Substitution
____ f. Other _____

J. ELECTRO-OPTICS

Definition: Electronic device or assembly which integrates electrical and optical signal carrying medium.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Type of Packaging	50%	50%	-
b. Lead Configuration	75%	25%	-
c. Coupling Techniques	33%	67%	-
d. Dimensions	33%	67%	-
e. Performance	67%	33%	-
f. Lot Size (Quantity/Time)	25%	-	75%
g. Other _____	____	____	____

2. What test and evaluation processes should be considered by an EC & C:

50% a. Dimensional
50% b. Signal Transmission
25% c. Parametrics
25% d. Other _____

K. HARDWARE

Definition: Various electro-mechanical and mechanical components utilized in the different categories of assemblies (e.g. knobs, dials, connectors, etc.).

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Type of Hardware	86%	10%	4%
b. Shape	74%	21%	5%
c. Mounting Technique	63%	21%	16%
d. Dimensions	70%	20%	10%
e. Base Material	22%	67%	11%
f. Surface Treatment	16%	58%	26%
g. Machining Operations	44%	39%	17%
h. Fabrication Operations	48%	33%	19%
i. Lot Size (Quantity/Time Unit)	37%	37%	26%
j. Custom or Standard	58%	33%	9%
k. Other _____	____	____	____

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

76% a. Dimensional
24% b. Metalurgical/Material
29% c. Aesthetics
33% d. Plating Analysis
____ e. Other _____

SECTION 3

COMMENTS

1. How do you feel about the application of Group Technology and an EC & C system in the electronics industry? (Optional)

   - I hope that you are successful. A simple system to locate process plans for a certain type of part is straight forward. The entire electronics industry covers so many different design and process technologies that you have a gigantic task. When you are done, any one user may only want a small portion of it at any one time. However, for many of us (and for large organizations) assignments and interests vary and a single, unified, E C & C system would be most useful. For instance, within the last year I have been working with printed circuit board (PWB), hybird assembly, ceramic thick film, and leadless chip carrier (LCC) components and assemblies. This includes proposals and cost estimating, development, and manufacturing methods, process plans and facilities.

     You might look, in particular, at the Navy Standard Electronics Module (SEM) program

   - I feel that Group Technology is the only thing that makes MIPLAN useful. In the mechanical applications, in here Group Technology is used (MICLASS). The ability to call up similar products is of prime importance. Without the ability to classify product and recall on this classification,, MIPLAN becomes nothing more than an expensive word processor.

   - Has possibilities and is currently applied to some degree.

   - The attempt to integrate the various systems and technologies into a common database will improve productivity and allow time spent producing paper to be spent advancing the technology.

   - I am torn between standardization and the effect, perhaps detrimental, on inventness. That is, if a design must adhere to the "standard", it may well not be pursued.

   - I think it's a very good idea (in theory). However, I would not put it into operation in our company until I've seen some successful stories of applications in other companies.

   - Effective use of Group Technology does require a high volume of in-house production to justify.

   - Would be worthwhile.

   - I feel that it certainly has an application in linking CAD/CAM. It has to increase productivity.

   - Use is questionable.

- It is not obvious what the benefits of GT and E C & C will be in the electronics industry. I believe we should do the following before we develop a system:

    1. Gather the good and bad experiences from a cross section of aerospace electronics companies in GT nd E C & C outside of fabricated parts.
    2. Create a detailed demonstration and/or scenario on how GT and E C & C would work in a factory that has multiple commodities (various assemblies and components). This would include: benefits, coding of piece parts and assemblies, grouping of tasks, computer aided process planning that leads to generative process planning and information retrieval.

- Group technology has its place at our plant whether by intent or accident it's already being used.
  If:
  1. All pc boards are designed for the automatic equipment that is here approximately 80% of all components are machine inserted.
  2. Wiring harnesses are all built in one area with common connection equipment.
  3. Simple mechanical bench type work is done in one area, etc.

- Badly needed.

- Would be helpful in reducing design time and hopefully create better designs.

- An E C & C System may be difficult to implement and maintain in the electronics industry due to the rapid evolution of technology.

- Viable and necessary.

- Very beneficial - maximum benefit will be realized from maximum participation. Proprietary data could be a negative factor.

- Testing in any group should not be a separate standard and not be confused with a coding system.

  The need for a standard coding system properly used provided all aspects of engineering with a unique advantage called standards communications.

- The use of GT in electronics and the assembly of electronics is probably more profitable than in the machining areas.

COMMENTS

2. If there are any issues or topics important to the development of an Electronics Classification and Coding System which this survey has not covered, please identify. If there are any comments you wish to add, please do so. Thank you for your participation.

- I am not familiar with Group Technology, and don't understand just how the E C & C System would be used. I think this survey form should have made clear the purpose of an E C & C System. I have assumed that it would be a computer based data storage system containing the information listed in this survey.

- I think you covered everything but let me list the kinds of things product designers will use the system for:
  Find a design with similar:
  a. Function.
  b. Frequency range & power.
  c. Weight and size.
  d. Subject to specific environment specs.
  e. Using a type of packaging.
  f. Using specific assembly techniques
  g. Containing specific materials.
  h. Type of parts.
  i. Weight of parts.
  j. Thermal cooling techniques.

- Please note this survey can be looked at from many perspectives and relative importance of each category changes.

- Automated and semi-automated processing and procedures must be addressed from a standardization standpoint. Collective data could help present divergent methods.

  Parts and material substitution data are extremely important to the repair and spares businesses.

- a. We assume dimensional inspection includes a visual.
  b. It would have been helpful to have a glossary with the survey.
  c. The survey was too long.
  d. Question 13 was confusing.
  e. I hope this survey starts the ball rolling on E C & C - the ECAM project will definitely address this subject.

- The survey may include the in-process quality control and inspection people and try to find out how E C & C can help them for their work.

- Relative to accurate completion of the survey - a better definition of what E C & C is, its applications, benefits etc. is necessary to help fully define its uses.

- I believe the main issue, in Government electronics, is whether classificaiton will ever be useful. I have, to date, never seen a previous design that was useful on a new project.

5.3 ELECTRONIC PRODUCT DESIGN

(13 responses)

ELECTRONICS CLASSIFICATION AND CODING SYSTEM SURVEY

Section 1

1. Name _____
   Company _____
   Position _____

2. Your present position is primarily involved with:
   27% a. Electronic Product Design
   ____ b. Electronic Product Manufacturing
   ____ c. Electronic Product Testing
   ____ d. Other _____

3. In which of the following areas do you have experience?
   8% a. Methods Engineering
   31% b. Manufacturing Engineering
   8% c. Process Engineering
   85% d. Design Engineering
   15% e. Test Engineering
   54% f. Development Engineering
   38% g. Research
   15% h. Industrial Engineering
   31% i. Product Support Engineering
   8% j. Other _____

4. How many years of experience do you have in the electronics industry?
   8% a. Up to 5
   8% b. 6 to 10
   31% c. 11 to 20
   53% d. More than 20

5. In which areas of electronics design/manufacturing do you have direct experience? (Check all that apply).

Present Job	Previous Jobs		
54%	54%	a.	Packaging (panels, covers, chassis, etc.)
62%	69%	b.	Wired Assemblies (cables, harnesses, point to point etc.)
62%	77%	c.	Printed Wiring Boards
38%	62%	d.	Discrete Components
62%	54%	e.	Integrated Circuits
38%	31%	f.	Hybrid Microelectronics
15%	15%	g.	Wire Wound Magnetic Components
54%	77%	h.	Electronic Assemblies
23%	31%	i.	Electro-Mechanical Assemblies
15%	31%	j.	Electro-Optics
62%	62%	k.	Hardware
8%	-	l.	Other _____

6. What percentage of your company's products are used in:
   _____ a. Military Applications
   _____ b. Commercial

7. If you currently have in use a method for providing standardization in design or manufacturing, it is:
   92% a. Formal And Automated
   - b. Formal But Manual
   - c. Informal
   - d. None In Use
   8% e. Other N/A

8. In order to be useful, an EC & C should support your work in the following areas:

	Very Useful	Useful	Somewhat Useful	Not Useful	N/A
a. Design Retrieval	69%	23%	-	-	8%
b. Process Documentation	15%	55%	-	15%	15%
c. Process Equipment Capacity Planning	-	15%	23%	31%	31%
d. New Processes/Designs	8%	38%	23%	8%	23%
e. Cost Appraisal	47%	23%	15%	-	15%
f. Design Standards	53%	31%	8%	-	8%
g. Manufacturing Standards	31%	38%	8%	-	23%
h. Retrieval of Alternate Parts	31%	46%	8%	-	15%
i. Obsolescence Appraisal	-	23%	46%	8%	23%
j. Have Ease of Maintenance	15%	15%	24%	15%	31%

9. In your view, what is an acceptable time to retrieve critical design or process information required to perform your function?
   23% a. Seconds
   46% b. Minutes
   23% c. Hours
   8% d. Days

10. If your company implements an EC & C system, which of the following advantages would be important to realize:

	Primary	Secondary	Not Important	N/A
a. Increase Your Competitive Position	77%	15%	-	8%
b. Increase Design Productivity	100%	-	-	-
c. Increase Manufacturing Productivity	77%	23%	-	-
d. Lower Product Costs	77%	15%	-	8%
e. Reduce Paperwork	69%	31%	-	-
f. Standardize Cost Evaluation Procedures	46%	46%	-	8%
g. Train Less Experienced Design/Mfg/ Test Engineers	15%	69%	8%	8%
h. Identify Emerging/Advanced/Obsolete Processes and Materials	31%	61%	8%	-
i. Shorten Elapsed Time Between Design And Production	84%	8%	-	8%
j. Utilize Knowledge & Experience of Existing Designs & Processes	62%	38%	-	-
k. Inventory Reduction	-	77%	15%	8%
l. Facilitate Automation of Manufacturing & Test Operations	38%	46%	8%	8%

11. In order to be valuable, an EC & C should use:

8%	a.	Industry Wide Normalized Data
46%	b.	Data Specific To Your Company
38%	c.	Both
8%		N/A

12. How familiar are you with the concept of Group Technology?

-	a.	Work Or Have Worked With It
38%	b.	Familiar But Have Not Used It
62%	c.	Not Familiar With Group Technology

13. Rate the significance of each of the following as a major electronic family grouping:

	Primary	Secondary	Not Important	N/A
a. Packaging (panels, covers, chassis, etc.)	62%	15%	8%	15%
b. Wired Assemblies (cables, harnesses, point to point)	62%	15%	15%	8%
c. Printed Wiring Boards	70%	-	15%	15%
d. Discrete Components	31%	54%	-	15%
e. Integrated Circuits	47%	38%	-	15%
f. Hybrid Microelectronics	46%	31%	8%	15%
g. Wire Wound Magnetic Components	15%	54%	8%	23%
h. Electronic Assemblies	62%	30%	-	8%
i. Electro-Magnetic Assemblies	23%	62%	-	15%
j. Electro-Optics	8%	61%	8%	23%
k. Hardware	38%	47%	-	15%
l. Other _____	-	8%	-	-

Section 2

A. PACKAGING

DEFINITION: Packaging encompasses the elements (components/assemblies) which are required to create a "black box" which will contain electronic components, (i.e. panels, covers, chassis, etc.).

1. Rate the following characteristics as to whether they should be considered in developing an EC & C.

	Primary	Secondary	Not Important	N/A
a. Shape	31%	31%	15%	23%
b. Shape Elements (holes, slots, etc.)	31%	38%	8%	23%
c. Position of Shape Elements	38%	31%	8%	23%
d. Number of Various Shape Elements (quantity)	23%	39%	15%	23%
e. Dimensions	62%	15%	-	23%
f. Tolerances	54%	23%	-	23%
g. Material	38%	39%	-	23%
h. Major Machining Operations	8%	54%	15%	23%
i. Major Fabrication Operations	23%	39%	15%	23%
j. Surface Treatments	8%	54%	15%	23%
k. Lot Size (quantity/time unit)	15%	47%	15%	23%
l. End Use of Package (internal, external)	31%	23%	23%	23%
m. Others _____	8%	-	-	-

2. What testing and evaluation processes which apply to the packaging category should be considered by an EC & C?

Check all that are applicable.

69%	a.	Dimensional Analysis
31%	b.	Metallurgical/Material Evaluation
69%	c.	Stress/Strength Analysis
8%	d.	Color, Texture (Aesthetic Evaluation)
38%	e.	Static Dissipation
85%	f.	EMI Shielding
8%	g.	Other N/A

B. WIRED ASSEMBLIES

Definition: An assembly consisting of multiconductor grouping of wires, point to point wiring, etched/additive wire assemblies, and/or flexible printed cables.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Number of Conductors	69%	23%	-	8%
b. Size of Conductors	69%	23%	-	8%
c. Type of End Terminations	61%	31%	-	8%
d. Type of Insulation	54%	31%	-	15%
e. Type of Base Material	31%	54%	-	15%
f. Type of Surface Plating	39%	46%	-	15%
g. Voltage/Current/Frequency Data	61%	31%	-	8%
h. Shielding	70%	15%	-	15%
i. Dimensions	77%	15%	-	8%
j. Number of Branches	39%	46%	-	15%
k. Type (e.g. Flat, Ribbon, Coax)	85%	-	-	15%
l. Lot Size (Quantity/Time Unit)	15%	55%	15%	15%
m. End Product Destination	8%	54%	23%	15%
n. Machine Operations	15%	55%	15%	15%
o. Manual Operations	15%	55%	15%	15%
p. Lot Size (Quantity/Time Unit)	8%	54%	15%	23%
q. Coating/Encapsulation	31%	46%	8%	15%
r. Joining Processes	31%	39%	15%	15%
s. Other _____	-	-	-	-

Wired Assemblies - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check all which apply

69%	a.	Dimensional
92%	b.	Opens/Shorts Testing
69%	c.	Impedence Testing
69%	d.	Hi-Pot Testing
54%	e.	Insulation Characteristics
38%	f.	Mechanical
31%	g.	Joining Processes
8%	h.	Other N/A

h. 23% Static
i. 23% Product Application
j. 46% Temperature Cycling
k. 31% Other N/A

F. HYBRID MICRO ELECTRONICS

Definition: A packaging technique that interconnects passive and/or semiconductor devices within a single package.

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	69%	8%	-	23%
b. Lead Arrangement	77%	-	-	23%
c. Number of Leads	77%	-	-	23%
d. Internal Circuit Types	61%	8%	8%	23%
e. Number of Internal Elements	38%	31%	8%	23%
f. Package Dimensions	62%	15%	-	23%
g. Lead Related Dimensions	54%	23%	-	23%
h. Circuit Parametric Specs	46%	31%	-	23%
i. Lot Size (Quantity)	15%	39%	23%	23%
j. Environmental Specs	38%	39%	-	23%
k. Other _____	-	-	-	-

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C.

Check all that apply

38% a. Physical Characteristics
46% b. Parametrics
62% c. Functional Testing
46% d. Static Testing
- e. Microsectioning
38% f. Pattern Sensitivity
38% g. Other N/A

G. WIRE WOUND MAGNETIC COMPONENTS

Definition: Any device which acts or reacts due to the electromagnetic field induced by current flowing through wire windings. This shall include transformers, actuators, rotary components and coils.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	69%	-	-	31%
b. Function	62%	7%	-	31%
c. Dimensions	69%	-	-	31%

	Primary	Secondary	Not Important	N/A
d. Electrical Data	62%	7%	-	31%
e. Winding Wire Data	46%	15%	8%	31%
f. Lamination Data	15%	38%	8%	38%
g. Adjustability	23%	38%	8%	31%
h. Type of Shielding/Sleeving	38%	31%	-	31%
i. External Lead Data	53%	8%	8%	31%
j. Machine Processes	-	31%	31%	38%
k. Major Fabrication Operations	-	31%	31%	38%
l. Coating/Encapsulation	23%	46%	-	31%
m. Lot Size (Quantity/Time Unit)	8%	31%	23%	38%
n. Other _____	-	-	-	-

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C:

Check all which apply:

54%	a. Induction
54%	b. Impedence
46%	c. Coupling
54%	d. Load Effects
46%	e. Excitation Current
46%	f. Permeability
62%	g. Voltage/Current/Frequency Data
46%	h. Hi-Pot
46%	i. Dimensions
46%	j. Resistance
38%	k. Other N/A

H. ELECTRONIC ASSEMBLIES (EA)

Definition: A final assembly or second level assembly which includes a printed circuit board. These shall contain electronic, mechanical, and/or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	47%	15%	15%	23%
b. Function	54%	15%	8%	23%
c. Tolerances	61%	8%	8%	23%
d. Type of Composite Components	46%	23%	8%	23%
e. Number of Composite Components	38%	31%	8%	23%
f. Lot Size (Quantity/Time Unit)	15%	39%	23%	23%
g. Major Fabrication Operations	-	54%	23%	23%
h. Component Spacing Information	46%	23%	8%	23%
i. Special Packaging	46%	31%	-	23%
j. Electrical Performance Specs	39%	38%	-	23%

C. PRINTED WIRING BOARDS (PWB)

Definition: A completely processed conductor pattern(s) all formed on a common base.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	46%	31%	8%	15%
b. Dimensions	54%	31%	-	15%
c. Lot Size (Quantity/Time Unit)	8%	54%	23%	15%
d. Tolerances	54%	23%	8%	15%
e. Type of Base Material	39%	46%	-	15%
f. Type of Conductive Material	46%	31%	8%	15%
g. Conductor Electrical Characteristics	54%	23%	8%	15%
h. Environment Requirements	39%	46%	-	15%
i. Printed Circuitry Processes	15%	55%	15%	15%
j. Hole Information (Size, Quantity, etc.)	54%	31%	-	15%
k. Number of Layers	70%	15%	-	15%
l. Types of Layers	70%	15%	-	15%
m. Plating Information	46%	31%	8%	15%
n. Masking & Coating	39%	38%	8%	15%
o. Other _____	-	-	8%	-

PWB - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check as apply

38% a. Bond Evaluation (Layer)
31% b. Bond Evaluation (Conductor)
31% c. Metallurgical Evaluation of Plating Quality
38% d. Impedence
54% e. Dimensional
54% f. Electrical Testing
31% g. Micro Sectioning
8% h. Other N/A

D. DISCRETE COMPONENT

Definition: Any passive or active electronic component, other than integrated circuits and hybrid microelectronics. (e.g. capacitors, resistors, switches, diodes, transistors, etc.).

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Package	70%	15%	-	15%
b. Lead Configuration	77%	8%	-	15%
c. Package Dimension	77%	8%	-	15%
d. Parametric Specs	39%	38%	8%	15%

	Primary	Secondary	Not Important	N/A
e. Environmental Specs	39%	46%	-	15%
f. Adjustability	8%	62%	15%	15%
g. Component Type	62%	23%	-	15%
h. Lot Size (Quantity/Time Unit)	15%	55%	15%	15%
i. Other _____	-	-	15%	-

2. What test and evaluation processes should be considered by an EC & C:

Check all that apply

54% a. Parametric
62% b. Functional
15% c. Chemical/ Metallurgical Analysis (Leads and Package)
- d. Microsectioning
54% e. Dimensional
31% f. Environmental
31% g. Other N/A

E. INTEGRATED CIRCUITS

Definition: A complex electronic semiconductor circuit, packaged as an individual component.

1. Rate the significance of the following charactristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type Of Packaging	77%	8%	-	15%
b. Lead Arrangements	85%	-	-	15%
c. Number Of Leads	85%	-	-	15%
d. Type By Function	77%	8%	-	15%
e. Scale Of Integration, (LSI, SSI, etc).	31%	46%	8%	15%
f. Overall Package Dimensions	70%	15%	-	15%
g. Circuit Performance	62%	23%	-	15%
h. Environmental Requirements	46%	39%	-	15%
i. Lot Size (Quantity/Time Unit)	15%	47%	23%	15%
j. Other _____	-	-	15%	-

Integrated Circuits - Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C?

Check all which apply:

38% a. Fine/Gross Leak Test
46% b. Parametric Testing
69% c. Functional Testing
31% d. Pattern Sensitivity Testing
62% e. Temperature
38% f. Burn-In
31% g. Dynamic

	Primary	Secondary	Not Important	N/A
k. Special Environmental Requirements	39%	38%	-	23%
l. Coating/Encapsulation	15%	62%	-	23%
m. Other _____	-	-	-	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

69% a. Functional Testing
62% b. In Circuit Testing
46% c. Parametrics
54% d. Dynamic Testing
46% e. In-Product Substitution
54% f. Environmental Chamber
31% g. Other N/A

I. ELECTRO-MECHANICAL ASSEMBLIES

Definition: A final or secondary level assembly which performs an electronic function, but is manufactured using basically mechanical operations such as staking, riviting, screws, bolting and hard mounting of electronic or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	54%	15%	8%	23%
b. Functions(s)	46%	23%	8%	23%
c. Dimensions	69%	-	8%	23%
d. Lotsize (Quantity/Time Unit)	8%	46%	23%	23%
e. Type of Electronic Components	31%	38%	8%	23%
f. Quantity of Electronic Components	47%	15%	15%	23%
g. Type of Mechanical Components	38%	31%	8%	23%
h. Quantity of Mechanical Components	54%	8%	15%	23%
i. Type of Electro-Optical Components	31%	23%	23%	23%
j. Quantity of Electro-Optical Components	39%	15%	23%	23%
k. Major Machining Operations	8%	54%	15%	23%
l. Major Assembly Operations	8%	54%	15%	23%
m. Coating/Encapsulation	15%	39%	23%	23%
n. Joining Processes	15%	47%	15%	23%
o. Other _____	-	-	-	-

Test Evaluation

69% a. Functional Testing
46% b. Parametrics
54% c. Point To Point Internal Interconnections
54% d. Dynamic
46% e. In-Product Substitution
31% f. Other N/A

J. ELECTRO-OPTICS

Definition: Electronic device or assembly which integrates electrical and optical signal carrying medium.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	46%	15%	8%	31%
b. Lead Configuration	54%	-	15%	31%
c. Coupling Techniques	46%	15%	8%	31%
d. Dimensions	61%	-	8%	31%
e. Performance	53%	8%	8%	31%
f. Lot Size (Quantity/Time)	8%	38%	23%	31%
g. Other _____	-	-	15%	-

2. What test and evaluation processes should be considered by an EC & C:

38% a. Dimensional
46% b. Signal Transmission
38% c. Parametrics
38% d. Other N/A

K. HARDWARE

Definition: Various electro-mechanical and mechanical components utilized in the different categories of assemblies (e.g. knobs, dials, connectors, etc.).

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Hardware	62%	-	-	38%
b. Shape	54%	23%	-	23%
c. Mounting Technique	61%	8%	8%	23%
d. Dimensions	69%	8%	-	23%
e. Base Material	46%	31%	-	23%
f. Surface Treatment	23%	39%	15%	23%
g. Machining Operations	8%	38%	31%	23%
h. Fabrication Operations	8%	38%	31%	23%
i. Lot Size (Quantity/Time Unit)	15%	31%	31%	23%
j. Custom or Standard	46%	23%	8%	23%
k. Other Electrical	8%	-	-	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

62% a. Dimensional
38% b. Metalurgical/Material
31% c. Aesthetics
23% d. Plating Analysis
31% e. Other N/A

5.4 ELECTRONIC PRODUCT MANUFACTURING

(18 responses)

ELECTRONICS CLASSIFICATION AND CODING SYSTEM SURVEY

Section 1

1. Name _____
   Company _____
   Position _____

2. Your present position is primarily involved with:
   - ____ a. Electronic Product Design
   - 37% b. Electronic Product Manufacturing
   - ____ c. Electronic Product Testing
   - ____ d. Other _____

3. In which of the following areas do you have experience?
   - 50% a. Methods Engineering
   - 100% b. Manufacturing Engineering
   - 61% c. Process Engineering
   - 67% d. Design Engineering
   - 28% e. Test Engineering
   - 44% f. Development Engineering
   - 17% g. Research
   - 44% h. Industrial Engineering
   - 33% i. Product Support Engineering
   - - j. Other _____

4. How many years of experience do you have in the electronics industry?
   - 6% a. Up to 5
   - 11% b. 6 to 10
   - 22% c. 11 to 20
   - 61% d. More than 20

5. In which areas of electronics design/manufacturing do you have direct experience? (Check all that apply).

Present Job	Previous Jobs		
39%	28%	a.	Packaging (panels, covers, chassis, etc.)
67%	50%	b.	Wired Assemblies (cables, harnesses, point to point etc.)
89%	50%	c.	Printed Wiring Boards
39%	33%	d.	Discrete Components
50%	33%	e.	Integrated Circuits
50%	33%	f.	Hybrid Microelectronics
39%	56%	g.	Wire Wound Magnetic Components
78%	56%	h.	Electronic Assemblies
67%	50%	i.	Electro-Mechanical Assemblies
17%	39%	j.	Electro-Optics
50%	39%	k.	Hardware
-	-	l.	Other _____

6. What percentage of your company's products are used in:

_____ a. Military Applications
_____ b. Commercial

7. If you currently have in use a method for providing standardization in design or manufacturing, it is:

19% a. Formal And Automated
41% b. Formal But Manual
17% c. Informal
6% d. None In Use
6% e. Other Persons not answering question

8. In order to be useful, an EC & C should support your work in the following areas:

	Very Useful	Useful	Somewhat Useful	Not Useful	N/A
a. Design Retrieval	61%	21%	6%	6%	6%
b. Process Documentation	61%	39%	-	-	-
c. Process Equipment Capacity Planning	50%	33%	17%	-	-
d. New Processes/Designs	67%	28%	5%	-	-
e. Cost Appraisal	50%	33%	17%	-	-
f. Design Standards	67%	22%	11%	-	-
g. Manufacturing Standards	67%	28%	5%	-	-
h. Retrieval of Alternate Parts	28%	56%	11%	5%	-
i. Obsolescence Appraisal	17%	39%	44%	-	-
j. *Have Ease of Maintenance*	56%	16%	28%	-	-

9. In your view, what is an acceptable time to retrieve critical design or process information required to perform your function?

11% a. Seconds
78% b. Minutes
11% c. Hours
- d. Days

10. If your company implements an EC & C system, which of the following advantages would be important to realize:

	Primary	Secondary	Not Important	N/A
a. Increase Your Competitive Position	55%	17%	11%	17%
b. Increase Design Productivity	55%	28%	-	17%
c. Increase Manufacturing Productivity	94%	-	-	6%
d. Lower Product Costs	67%	22%	-	11%
e. Reduce Paperwork	67%	27%	-	6%
f. Standardize Cost Evaluation Procedures	22%	67%	-	11%
g. Train Less Experienced Design/Mfg/ Test Engineers	22%	56%	11%	11%
h. Identify Emerging/Advanced/Obsolete Processes and Materials	39%	50%	-	11%
i. Shorten Elapsed Time Between Design And Production	83%	11%	-	6%
j. Utilize Knowledge & Experience of Existing Designs & Processes	78%	11%	-	11%
k. Inventory Reduction	33%	50%	6%	11%
l. Facilitate Automation of Manufacturing & Test Operations	61%	28%	-	11%

11. In order to be valuable, an EC & C should use:
    - 28% a. Industry Wide Normalized Data
    - 22% b. Data Specific To Your Company
    - 50% c. Both

12. How familiar are you with the concept of Group Technology?
    - 17% a. Work Or Have Worked With It
    - 56% b. Familiar But Have Not Used It
    - 28% c. Not Familiar With Group Technology

13. Rate the significance of each of the following as a major electronic family grouping:

	Primary	Secondary	Not Important	N/A
a. Packaging (panels, covers, chassis, etc.)	50%	33%	11%	6%
b. Wired Assemblies (cables, harnesses, point to point)	44%	39%	11%	6%
c. Printed Wiring Boards	67%	33%	-	-
d. Discrete Components	55%	39%	-	6%
e. Integrated Circuits	66%	28%	6%	-
f. Hybrid Microelectronics	44%	50%	6%	-
g. Wire Wound Magnetic Components	39%	44%	11%	6%
h. Electronic Assemblies	83%	17%	-	-
i. Electro-Magnetic Assemblies	44%	44%	6%	6%
j. Electro-Optics	33%	39%	17%	11%
k. Hardware	44%	28%	22%	6%
l. Other _____	-	-	-	-

Section 2

A. PACKAGING

DEFINITION: Packaging encompasses the elements (components/assemblies) which are required to create a "black box" which will contain electronic components, (i.e. panels, covers, chassis, etc.).

1. Rate the following characteristics as to whether they should be considered in developing an EC & C.

	Primary	Secondary	Not Important	N/A
a. Shape	33%	39%	-	28%
b. Shape Elements (holes, slots, etc.)	28%	44%	-	28%
c. Position of Shape Elements	33%	39%	-	28%
d. Number of Various Shape Elements (quantity)	28%	44%	-	28%
e. Dimensions	39%	33%	-	28%
f. Tolerances	55%	17%	-	28%
g. Material	55%	17%	6%	22%
h. Major Machining Operations	33%	33%	6%	28%
i. Major Fabrication Operations	50%	22%	-	28%
j. Surface Treatments	28%	44%	-	28%
k. Lot Size (quantity/time unit)	28%	33%	11%	28%
l. End Use of Package (internal, external)	11%	28%	33%	28%
m. Others _____	-	-	-	-

2. What testing and evaluation processes which apply to the packaging category should be considered by an EC & C?

Check all that are applicable.

61% a. Dimensional Analysis
33% b. Metallurgical/Material Evaluation
56% c. Stress/Strength Analysis
28% d. Color, Texture (Aesthetic Evaluation)
56% e. Static Dissipation
72% f. EMI Shielding
22% g. Other Persons not answering questions

B. WIRED ASSEMBLIES

Definition: An assembly consisting of multiconductor grouping of wires, point to point wiring, etched/additive wire assemblies, and/or flexible printed cables.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Number of Conductors	71%	6%	6%	17%
b. Size of Conductors	72%	11%	-	17%
c. Type of End Terminations	72%	11%	-	17%
d. Type of Insulation	28%	55%	-	17%
e. Type of Base Material	22%	55%	6%	17%
f. Type of Surface Plating	28%	44%	11%	17%
g. Voltage/Current/Frequency Data	44%	23%	11%	22%
h. Shielding	55%	28%	-	17%
i. Dimensions	71%	6%	6%	17%
j. Number of Branches	50%	22%	11%	17%
k. Type (e.g. Flat, Ribbon, Coax)	71%	6%	6%	17%
l. Lot Size (Quantity/Time Unit)	28%	33%	22%	17%
m. End Product Destination	6%	50%	27%	17%
n. Machine Operations	27%	50%	6%	17%
o. Manual Operations	22%	55%	6%	17%
p. Lot Size (Quantity/Time Unit)	28%	28%	22%	22%
q. Coating/Encapsulation	28%	44%	6%	22%
r. Joining Processes	44%	34%	-	22%
s. Other _____	11%	-	-	-

Wired Assemblies - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check all which apply

61% a. Dimensional
78% b. Opens/Shorts Testing
33% c. Impedence Testing
50% d. Hi-Pot Testing
50% e. Insulation Characteristics
56% f. Mechanical
39% g. Joining Processes
22% N/A

C. PRINTED WIRING BOARDS (PWB)

Definition: A completely processed conductor pattern(s) all formed on a common base.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	55%	33%	6%	6%
b. Dimensions	66%	28%	-	6%
c. Lot Size (Quantity/Time Unit)	33%	22%	39%	6%
d. Tolerances	60%	28%	6%	6%
e. Type of Base Material	55%	28%	11%	6%
f. Type of Conductive Material	60%	28%	6%	6%
g. Conductor Electrical Characteristics	28%	60%	6%	6%
h. Environment Requirements	44%	33%	17%	6%
i. Printed Circuitry Processes	39%	44%	11%	6%
j. Hole Information (Size, Quantity, etc.)	83%	11%	-	6%
k. Number of Layers	83%	11%	-	6%
l. Types of Layers	44%	44%	6%	6%
m. Plating Information	44%	50%	-	6%
n. Masking & Coating	61%	22%	11%	6%
o. Other _____	11%	-	-	-

PWB - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check as apply

50% a. Bond Evaluation (Layer)
56% b. Bond Evaluation (Conductor)
61% c. Metallurgical Evaluation of Plating Quality
28% d. Impedence
78% e. Dimensional
78% f. Electrical Testing
44% g. Micro Sectioning
11% h. Other UL/CSA Approved
6% N/A

D. DISCRETE COMPONENT

Definition: Any passive or active electronic component, other than integrated circuits and hybrid microelectronics. (e.g. capacitors, resistors, switches, diodes, transistors, etc.)

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Package	78%	-	-	22%
b. Lead Configuration	78%	-	-	22%
c. Package Dimension	67%	11%	-	22%
d. Parametric Specs	39%	33%	6%	22%

	Primary	Secondary	Not Important	N/A
e. Environmental Specs	39%	33%	6%	22%
f. Adjustability	22%	45%	11%	22%
g. Component Type	66%	6%	6%	22%
h. Lot Size (Quantity/Time Unit)	22%	22%	34%	22%
i. Other _____	-	-	-	-

2. What test and evaluation processes should be considered by an EC & C:

Check all that apply

61% a. Parametric
78% b. Functional
44% c. Chemical/ Metallurgical Analysis (Leads and Package)
6% d. Microsectioning
50% e. Dimensional
44% f. Environmental
22% g. N/A

E. INTEGRATED CIRCUITS

Definition: A complex electronic semiconductor circuit, packaged as an individual component.

1. Rate the significance of the following charactristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type Of Packaging	77%	6%	-	17%
b. Lead Arrangements	77%	6%	-	17%
c. Number Of Leads	72%	11%	-	17%
d. Type By Function	33%	50%	-	17%
e. Scale Of Integration, (LSI, SSI, etc).	28%	38%	17%	17%
f. Overall Package Dimensions	56%	27%	-	17%
g. Circuit Performance	50%	22%	11%	17%
h. Environmental Requirements	33%	44%	6%	17%
i. Lot Size (Quantity/Time Unit)	22%	28%	33%	17%
j. Other Static Sensativity	6%	-	-	17%

Integrated Circuits - Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C?

Check all which apply:

44% a. Fine/Gross Leak Test
56% b. Parametric Testing
78% c. Functional Testing
33% d. Pattern Sensitivity Testing
56% e. Temperature
72% f. Burn-In
72% g. Dynamic

h. 50% Static
i. 28% Product Application
j. 67% Temperature Cycling
k. 22% Other N/A

F. HYBRID MICRO ELECTRONICS

Definition: A packaging technique that interconnects passive and/or semiconductor devices within a single package.

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	66%	6%	-	28%
b. Lead Arrangement	66%	6%	-	28%
c. Number of Leads	55%	17%	-	28%
d. Internal Circuit Types	11%	50%	11%	28%
e. Number of Internal Elements	11%	55%	6%	28%
f. Package Dimensions	61%	11%	-	28%
g. Lead Related Dimensions	55%	17%	-	28%
h. Circuit Parametric Specs	33%	33%	-	33%
i. Lot Size (Quantity)	17%	22%	33%	28%
j. Environmental Specs	33%	33%	6%	28%
k. Other Static Sensativity	6%	-	-	-

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C.

Check all that apply

67% a. Physical Characteristics
61% b. Parametrics
72% c. Functional Testing
44% d. Static Testing
22% e. Microsectioning
28% f. Pattern Sensitivity
28% g. Other N/A

G. WIRE WOUND MAGNETIC COMPONENTS

Definition: Any device which acts or reacts due to the electromagnetic field induced by current flowing through wire windings. This shall include transformers, actuators, rotary components and coils.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	72%	6%	-	22%
b. Function	56%	22%	-	22%
c. Dimensions	72%	6%	-	22%

	Primary	Secondary	Not Important	N/A
d. Electrical Data	56%	22%	-	22%
e. Winding Wire Data	44%	34%	-	22%
f. Lamination Data	28%	50%	-	22%
g. Adjustability	22%	45%	11%	22%
h. Type of Shielding/Sleeving	39%	39%	-	22%
i. External Lead Data	72%	6%	-	22%
j. Machine Processes	17%	50%	11%	22%
k. Major Fabrication Operations	28%	39%	11%	22%
l. Coating/Encapsulation	61%	17%	-	22%
m. Lot Size (Quantity/Time Unit)	17%	22%	33%	28%
n. Other _____	-	-	-	-

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C:

Check all which apply:

78% a. Induction
72% b. Impedence
67% c. Coupling
67% d. Load Effects
56% e. Excitation Current
39% f. Permeability
72% g. Voltage/Current/Frequency Data
72% h. Hi-Pot
72% i. Dimensions
56% j. Resistance
22% k. Other N/A

H. ELECTRONIC ASSEMBLIES (EA)

Definition: A final assembly or second level assembly which includes a printed circuit board. These shall contain electronic, mechanical, and/or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	56%	22%	-	22%
b. Function	50%	22%	6%	22%
c. Tolerances	50%	28%	-	22%
d. Type of Composite Components	33%	39%	6%	22%
e. Number of Composite Components	39%	33%	6%	22%
f. Lot Size (Quantity/Time Unit)	28%	17%	33%	22%
g. Major Fabrication Operations	44%	34%	-	22%
h. Component Spacing Information	44%	34%	-	22%
i. Special Packaging	61%	17%	-	22%
j. Electrical Performance Specs	44%	34%	-	22%

	Primary	Secondary	Not Important	N/A
k. Special Environmental Requirements	44%	28%	6%	22%
l. Coating/Encapsulation	39%	28%	11%	22%
m. Other _____	-	-	-	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

72% a. Functional Testing
67% b. In Circuit Testing
44% c. Parametrics
67% d. Dynamic Testing
22% e. In-Product Substitution
44% f. Environmental Chamber
28% g. Other N/A

I. ELECTRO-MECHANICAL ASSEMBLIES

Definition: A final or secondary level assembly which performs an electronic function, but is manufactured using basically mechanical operations such as staking, riviting, screws, bolting and hard mounting of electronic or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	55%	17%	-	28%
b. Functions(s)	50%	16%	6%	28%
c. Dimensions	72%	-	-	28%
d. Lotsize (Quantity/Time Unit)	22%	22%	28%	28%
e. Type of Electronic Components	50%	22%	-	28%
f. Quantity of Electronic Components	39%	33%	-	28%
g. Type of Mechanical Components	50%	22%	-	28%
h. Quantity of Mechanical Components	44%	28%	-	28%
i. Type of Electro-Optical Components	44%	28%	-	28%
j. Quantity of Electro-Optical Components	33%	39%	-	28%
k. Major Machining Operations	44%	28%	-	28%
l. Major Assembly Operations	55%	17%	-	28%
m. Coating/Encapsulation	28%	39%	-	33%
n. Joining Processes	39%	33%	-	28%
o. Other _____	-	-	-	-

Test Evaluation

61% a. Functional Testing
39% b. Parametrics
56% c. Point To Point Internal Interconnections
50% d. Dynamic
22% e. In-Product Substitution
6% f. Other Mechanical
28% N/A

J. ELECTRO-OPTICS

Definition: Electronic device or assembly which integrates electrical and optical signal carrying medium.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	56%	11%	-	33%
b. Lead Configuration	67%	-	-	33%
c. Coupling Techniques	44%	23%	-	33%
d. Dimensions	61%	6%	-	33%
e. Performance	56%	11%	-	33%
f. Lot Size (Quantity/Time)	11%	22%	28%	39%
g. Other _____	-	-	-	-

2. What test and evaluation processes should be considered by an EC & C:

50% a. Dimensional
56% b. Signal Transmission
33% c. Parametrics
6% d. Other Environmental Static Dynamic
39% N/A

K. HARDWARE

Definition: Various electro-mechanical and mechanical components utilized in the different categories of assemblies (e.g. knobs, dials, connectors, etc.).

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Hardware	61%	6%	-	33%
b. Shape	56%	11%	-	33%
c. Mounting Technique	50%	17%	-	33%
d. Dimensions	56%	11%	-	33%
e. Base Material	17%	50%	-	33%
f. Surface Treatment	23%	44%	-	33%
g. Machining Operations	28%	39%	-	33%
h. Fabrication Operations	33%	33%	-	33%
i. Lot Size (Quantity/Time Unit)	22%	17%	28%	33%
j. Custom or Standard	33%	33%	-	33%
k. Other _____	-	-	-	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

61% a. Dimensional
17% b. Metalurgical/Material
33% c. Aesthetics
44% d. Plating Analysis
33% e. Other N/A

5.5 ELECTRONIC PRODUCT MANUFACTURING/TESTING

(7 responses)

Note: In reviewing the total population, this group was included in the Electronic Product Manufacturing Population.

ELECTRONICS CLASSIFICATION AND CODING SYSTEM SURVEY

Section 1

1. Name_____
   Company_____
   Position_____

2. Your present position is primarily involved with:
   - ____ a. Electronic Product Design
   - ____ b. Electronic Product Manufacturing
   - 11% c. Electronic Product Testing
   - ____ d. Other _____

3. In which of the following areas do you have experience?
   - 20% a. Methods Engineering
   - 60% b. Manufacturing Engineering
   - \- c. Process Engineering
   - 40% d. Design Engineering
   - 80% e. Test Engineering
   - 60% f. Development Engineering
   - 20% g. Research
   - \- h. Industrial Engineering
   - 20% i. Product Support Engineering
   - \- j. Other _____

4. How many years of experience do you have in the electronics industry?
   - 20% a. Up to 5
   - \- b. 6 to 10
   - 60% c. 11 to 20
   - 20% d. More than 20

5. In which areas of electronics design/manufacturing do you have direct experience? (Check all that apply).

Present Job	Previous Jobs		
20%	20%	a.	Packaging (panels, covers, chassis, etc.)
60%	60%	b.	Wired Assemblies (cables, harnesses, point to point etc.)
40%	40%	c.	Printed Wiring Boards
\-	20%	d.	Discrete Components
20%	20%	e.	Integrated Circuits
20%	\-	f.	Hybrid Microelectronics
\-	\-	g.	Wire Wound Magnetic Components
60%	60%	h.	Electronic Assemblies
60%	40%	i.	Electro-Mechanical Assemblies
\-	20%	j.	Electro-Optics
20%	20%	k.	Hardware
\-	\-	l.	Other _____

6. What percentage of your company's products are used in:
   _____ a. Military Applications
   _____ b. Commercial

7. If you currently have in use a method for providing standardization in design or manufacturing, it is:
   20% a. Formal And Automated
   10% b. Formal But Manual
   40% c. Informal
   - d. None In Use
   10% e. Other Some automated documentation support systems
   20% N/A

8. In order to be useful, an EC & C should support your work in the following areas:

	Very Useful	Useful	Somewhat Useful	Not Useful	N/A
a. Design Retrieval	40%	20%	20%	-	20%
b. Process Documentation	20%	40%	40%	-	-
c. Process Equipment Capacity Planning	20%	20%	40%	20%	-
d. New Processes/Designs	20%	40%	20%	-	20%
e. Cost Appraisal	40%	-	40%	-	20%
f. Design Standards	60%	-	20%	-	20%
g. Manufacturing Standards	60%	20%	-	20%	-
h. Retrieval of Alternate Parts	40%	40%	-	-	20%
i. Obsolescence Appraisal	-	20%	60%	-	20%
j. Have Ease of Maintenance	20%	20%	40%	20%	-

9. In your view, what is an acceptable time to retrieve critical design or process information required to perform your function?
   - a. Seconds
   60% b. Minutes
   20% c. Hours
   20% d. Days

10. If your company implements an EC & C system, which of the following advantages would be important to realize:

	Primary	Secondary	Not Important	N/A
a. Increase Your Competitive Position	20%	40%	-	40%
b. Increase Design Productivity	80%	20%	-	-
c. Increase Manufacturing Productivity	60%	20%	20%	-
d. Lower Product Costs	60%	40%	-	-
e. Reduce Paperwork	40%	60%	-	-
f. Standardize Cost Evaluation Procedures	-	80%	-	20%
g. Train Less Experienced Design/Mfg/ Test Engineers	-	60%	20%	20%
h. Identify Emerging/Advanced/Obsolete Processes and Materials	40%	40%	-	20%
i. Shorten Elapsed Time Between Design And Production	80%	-	-	20%
j. Utilize Knowledge & Experience of Existing Designs & Processes	60%	40%	-	-
k. Inventory Reduction	40%	20%	20%	20%
l. Facilitate Automation of Manufacturing & Test Operations	60%	20%	20%	-

11. In order to be valuable, an EC & C should use:
- \- a. Industry Wide Normalized Data
- \- b. Data Specific To Your Company
- 100% c. Both

12. How familiar are you with the concept of Group Technology?
- 20% a. Work Or Have Worked With It
- 20% b. Familiar But Have Not Used It
- 60% c. Not Familiar With Group Technology

13. Rate the significance of each of the following as a major electronic family grouping:

	Primary	Secondary	Not Important	N/A
a. Packaging (panels, covers, chassis, etc.)	-	80%	-	20%
b. Wired Assemblies (cables, harnesses, point to point)	-	100%	-	-
c. Printed Wiring Boards	60%	40%	-	-
d. Discrete Components	80%	-	-	20%
e. Integrated Circuits	80%	-	-	20%
f. Hybrid Microelectronics	60%	20%	-	20%
g. Wire Wound Magnetic Components	40%	20%	20%	20%
h. Electronic Assemblies	100%	-	-	-
i. Electro-Magnetic Assemblies	40%	20%	20%	20%
j. Electro-Optics	20%	40%	20%	20%
k. Hardware	20%	60%	-	20%
l. Other _____	-	-	-	-

Section 2

A. PACKAGING

DEFINITION: Packaging encompasses the elements (components/assemblies) which are required to create a "black box" which will contain electronic components, (i.e. panels, covers, chassis, etc.).

1. Rate the following characteristics as to whether they should be considered in developing an EC & C.

	Primary	Secondary	Not Important	N/A
a. Shape	60%	-	-	40%
b. Shape Elements (holes, slots, etc.)	20%	40%	-	40%
c. Position of Shape Elements	-	60%	-	40%
d. Number of Various Shape Elements (quantity)	40%	20%	-	40%
e. Dimensions	40%	40%	-	20%
f. Tolerances	20%	40%	-	40%
g. Material	40%	20%	-	40%
h. Major Machining Operations	40%	20%	-	40%
i. Major Fabrication Operations	20%	40%	-	40%
j. Surface Treatments	-	60%	-	40%
k. Lot Size (quantity/time unit)	40%	40%	-	20%
l. End Use of Package (internal, external)	-	60%	-	40%
m. Others Location of test connectors	20%	-	-	-

2. What testing and evaluation processes which apply to the packaging category should be considered by an EC & C?

Check all that are applicable.

80% a. Dimensional Analysis
20% b. Metallurgical/Material Evaluation
40% c. Stress/Strength Analysis
20% d. Color, Texture (Aesthetic Evaluation)
20% e. Static Dissipation
40% f. EMI Shielding
20% g. Other Persons not answering

B. WIRED ASSEMBLIES

Definition: An assembly consisting of multiconductor grouping of wires, point to point wiring, etched/additive wire assemblies, and/or flexible printed cables.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Number of Conductors	60%	40%	-	-
b. Size of Conductors	40%	60%	-	-
c. Type of End Terminations	60%	20%	-	20%
d. Type of Insulation	80%	20%	-	-
e. Type of Base Material	20%	40%	20%	20%
f. Type of Surface Plating	20%	60%	-	20%
g. Voltage/Current/Frequency Data	80%	20%	-	-
h. Shielding	80%	20%	-	-
i. Dimensions	40%	40%	-	20%
j. Number of Branches	60%	20%	20%	-
k. Type (e.g. Flat, Ribbon, Coax)	40%	40%	-	20%
l. Lot Size (Quantity/Time Unit)	40%	40%	-	20%
m. End Product Destination	-	40%	40%	20%
n. Machine Operations	-	60%	20%	20%
o. Manual Operations	20%	60%	-	20%
p. Lot Size (Quantity/Time Unit)	-	60%	20%	20%
q. Coating/Encapsulation	-	80%	-	20%
r. Joining Processes	20%	40%	20%	20%
s. Other UL/CSA	20%	-	-	-

Wired Assemblies - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check all which apply

60% a. Dimensional
100% b. Opens/Shorts Testing
60% c. Impedence Testing
80% d. Hi-Pot Testing
60% e. Insulation Characteristics
60% f. Mechanical
80% g. Joining Processes
- h. Other

C. PRINTED WIRING BOARDS (PWB)

Definition: A completely processed conductor pattern(s) all formed on a common base.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	40%	20%	-	40%
b. Dimensions	60%	-	-	40%
c. Lot Size (Quantity/Time Unit)	-	60%	-	40%
d. Tolerances	20%	40%	-	40%
e. Type of Base Material	-	60%	-	40%
f. Type of Conductive Material	-	60%	-	40%
g. Conductor Electrical Characteristics	40%	20%	-	40%
h. Environment Requirements	40%	20%	-	40%
i. Printed Circuitry Processes	40%	20%	-	40%
j. Hole Information (Size, Quantity, etc.)	20%	40%	-	40%
k. Number of Layers	60%	-	-	40%
l. Types of Layers	60%	-	-	40%
m. Plating Information	-	60%	-	40%
n. Masking & Coating	-	60%	-	40%
o. Other _____	-	-	-	-

PWB - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check as apply

40% a. Bond Evaluation (Layer)
40% b. Bond Evaluation (Conductor)
40% c. Metallurgical Evaluation of Plating Quality
40% d. Impedence
60% e. Dimensional
60% f. Electrical Testing
40% g. Micro Sectioning
20% h. Other Shorts/Continuity Testing

D. DISCRETE COMPONENT

Definition: Any passive or active electronic component, other than integrated circuits and hybrid microelectronics. (e.g. capacitors, resistors, switches, diodes, transistors, etc.)

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Package	60%	-	-	40%
b. Lead Configuration	60%	20%	-	20%
c. Package Dimension	60%	-	-	40%
d. Parametric Specs	80%	-	-	20%

	Primary	Secondary	Not Important	N/A
e. Environmental Specs	40%	20%	-	40%
f. Adjustability	20%	40%	-	40%
g. Component Type	40%	20%	-	40%
h. Lot Size (Quantity/Time Unit)	-	60%	-	40%
i. Other _____	-	-	-	-

2. What test and evaluation processes should be considered by an EC & C:

Check all that apply

60% a. Parametric
60% b. Functional
40% c. Chemical/ Metallurgical Analysis (Leads and Package)
20% d. Microsectioning
60% e. Dimensional
60% f. Environmental
20% g. Other Burn-In
20% N/A

E. INTEGRATED CIRCUITS

Definition: A complex electronic semiconductor circuit, packaged as an individual component.

1. Rate the significance of the following charactristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type Of Packaging	60%	-	-	40%
b. Lead Arrangements	60%	-	-	40%
c. Number Of Leads	60%	-	-	40%
d. Type By Function	60%	20%	-	20%
e. Scale Of Integration, (LSI, SSI, etc).	20%	40%	-	40%
f. Overall Package Dimensions	60%	-	-	40%
g. Circuit Performance	60%	20%	-	20%
h. Environmental Requirements	40%	20%	-	40%
i. Lot Size (Quantity/Time Unit)	-	60%	-	40%
j. Other _____	-	-	-	-

Integrated Circuits - Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C?

Check all which apply:

- a. Fine/Gross Leak Test
60% b. Parametric Testing
60% c. Functional Testing
40% d. Pattern Sensitivity Testing
60% e. Temperature
80% f. Burn-In
60% g. Dynamic

h. 60% Static
i. 40% Product Application
j. 60% Temperature Cycling
k. 20% Other Persons not answering

F. HYBRID MICRO ELECTRONICS

Definition: A packaging technique that interconnects passive and/or semiconductor devices within a single package.

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	40%	20%	-	40%
b. Lead Arrangement	60%	-	-	40%
c. Number of Leads	40%	20%	-	40%
d. Internal Circuit Types	20%	40%	-	40%
e. Number of Internal Elements	20%	20%	20%	40%
f. Package Dimensions	40%	20%	-	40%
g. Lead Related Dimensions	20%	40%	-	40%
h. Circuit Parametric Specs	40%	20%	-	40%
i. Lot Size (Quantity)	-	60%	-	40%
j. Environmental Specs	40%	20%	-	40%
k. Other _____	-	-	-	-

Test/Evaluation

2. What test evaluation processes should be considered by an EC & C.

Check all that apply

60% a. Physical Characteristics
60% b. Parametrics
60% c. Functional Testing
60% d. Static Testing
20% e. Microsectioning
40% f. Pattern Sensitivity
20% g. Other Burn-In
20% . N/A

G. WIRE WOUND MAGNETIC COMPONENTS

Definition: Any device which acts or reacts due to the electromagnetic field induced by current flowing through wire windings. This shall include transformers, actuators, rotary components and coils.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	20%	-	20%	60%
b. Function	60%	-	-	40%
c. Dimensions	60%	-	-	40%

	Primary	Secondary	Not Important	N/A
d. Electrical Data	60%	-	-	40%
e. Winding Wire Data	40%	20%	-	40%
f. Lamination Data	20%	40%	-	40%
g. Adjustability	20%	20%	-	60%
h. Type of Shielding/Sleeving	20%	40%	-	40%
i. External Lead Data	40%	-	-	60%
j. Machine Processes	-	20%	-	80%
k. Major Fabrication Operations	-	20%	-	80%
l. Coating/Encapsulation	-	60%	-	40%
m. Lot Size (Quantity/Time Unit)	-	20%	-	80%
n. Other _____	-	-	-	-

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C:

Check all which apply:

60%	a.	Induction
60%	b.	Impedence
60%	c.	Coupling
60%	d.	Load Effects
40%	e.	Excitation Current
40%	f.	Permeability
60%	g.	Voltage/Current/Frequency Data
40%	h.	Hi-Pot
20%	i.	Dimensions
40%	j.	Resistance
20%	k.	Other Burn-In
40%		N/A

H. ELECTRONIC ASSEMBLIES (EA)

Definition: A final assembly or second level assembly which includes a printed circuit board. These shall contain electronic, mechanical, and/or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	40%	20%	20%	20%
b. Function	100%	-	-	-
c. Tolerances	40%	20%	20%	20%
d. Type of Composite Components	20%	60%	-	20%
e. Number of Composite Components	20%	60%	-	20%
f. Lot Size (Quantity/Time Unit)	-	80%	-	20%
g. Major Fabrication Operations	40%	20%	-	40%
h. Component Spacing Information	-	80%	-	20%
i. Special Packaging	20%	60%	-	20%
j. Electrical Performance Specs	80%	-	-	20%

		Primary	Secondary	Not Important	N/A
k.	Special Environmental Requirements	60%	20%	-	20%
l.	Coating/Encapsulation	-	80%	-	20%
m.	Other Location connectors & components	20%	-	-	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

100%	a.	Functional Testing
100%	b.	In Circuit Testing
40%	c.	Parametrics
60%	d.	Dynamic Testing
20%	e.	In-Product Substitution
60%	f.	Environmental Chamber
20%	g.	Other Burn-In

I. ELECTRO-MECHANICAL ASSEMBLIES

Definition: A final or secondary level assembly which performs an electronic function, but is manufactured using basically mechanical operations such as staking, riviting, screws, bolting and hard mounting of electronic or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

		Primary	Secondary	Not Important	N/A
a.	Shape	40%	20%	-	40%
b.	Functions(s)	80%	-	-	20%
c.	Dimensions	80%	-	-	20%
d.	Lotsize (Quantity/Time Unit)	-	80%	-	20%
e.	Type of Electronic Components	40%	40%	-	20%
f.	Quantity of Electronic Components	-	80%	-	20%
g.	Type of Mechanical Components	60%	20%	-	20%
h.	Quantity of Mechanical Components	-	80%	-	20%
i.	Type of Electro-Optical Components	60%	20%	-	20%
j.	Quantity of Electro-Optical Components	-	80%	-	20%
k.	Major Machining Operations	40%	20%	-	40%
l.	Major Assembly Operations	40%	20%	-	40%
m.	Coating/Encapsulation	20%	40%	-	40%
n.	Joining Processes	40%	20%	-	40%
o.	Other	-	-	-	-

Test Evaluation

80%	a.	Functional Testing
40%	b.	Parametrics
60%	c.	Point To Point Internal Interconnections
80%	d.	Dynamic
40%	e.	In-Product Substitution
20%	f.	Other Burn-In
~~20%~~		N/A

J. ELECTRO-OPTICS

Definition: Electronic device or assembly which integrates electrical and optical signal carrying medium.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	40%	-	-	60%
b. Lead Configuration	20%	20%	-	60%
c. Coupling Techniques	40%	-	-	60%
d. Dimensions	20%	20%	-	60%
e. Performance	40%	-	-	60%
f. Lot Size (Quantity/Time)	-	40%	-	60%
g. Other _____	-	-	-	-

2. What test and evaluation processes should be considered by an EC & C:

20% a. Dimensional
40% b. Signal Transmission
40% c. Parametrics
20% d. Other Burn-In
60% N/A

K. HARDWARE

Definition: Various electro-mechanical and mechanical components utilized in the different categories of assemblies (e.g. knobs, dials, connectors, etc.).

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Hardware	40%	20%	-	40%
b. Shape	20%	40%	-	40%
c. Mounting Technique	20%	40%	-	40%
d. Dimensions	20%	40%	-	40%
e. Base Material	-	40%	-	60%
f. Surface Treatment	-	40%	-	60%
g. Machining Operations	-	40%	-	60%
h. Fabrication Operations	-	40%	-	60%
i. Lot Size (Quantity/Time Unit)	-	60%	-	40%
j. Custom or Standard	20%	40%	-	40%
k. Other _____	-	-	-	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

60% a. Dimensional
40% b. Metalurgical/Material
60% c. Aesthetics
20% d. Plating Analysis
40% e. Other Persons not answering

5.6 ELECTRONIC PRODUCT MANUFACTURING/TESTING

(7 responses)

Note: In reviewing the total population, this group was included in the Electronic Product Manufacturing Population.

ELECTRONICS CLASSIFICATION AND CODING SYSTEM SURVEY

Section 1

1. Name_____
   Company_____
   Position_____

2. Your present position is primarily involved with:
   - ____ a. Electronic Product Design
   - 15% { ____ b. Electronic Product Manufacturing
   - ____ c. Electronic Product Testing
   - ____ d. Other _____

3. In which of the following areas do you have experience?
   - 57% a. Methods Engineering
   - 71% b. Manufacturing Engineering
   - 57% c. Process Engineering
   - 14% d. Design Engineering
   - 100% e. Test Engineering
   - 14% f. Development Engineering
   - \- g. Research
   - 43% h. Industrial Engineering
   - 29% i. Product Support Engineering
   - 14% j. Other Quality Engineering

4. How many years of experience do you have in the electronics industry?
   - \- a. Up to 5
   - \- b. 6 to 10
   - 43% c. 11 to 20
   - 57% d. More than 20

5. In which areas of electronics design/manufacturing do you have direct experience? (Check all that apply).

Present Job	Previous Jobs		
29%	43%	a.	Packaging (panels, covers, chassis, etc.)
57%	43%	b.	Wired Assemblies (cables, harnesses, point to point etc.)
86%	57%	c.	Printed Wiring Boards
57%	57%	d.	Discrete Components
57%	71%	e.	Integrated Circuits
43%	57%	f.	Hybrid Microelectronics
\-	29%	g.	Wire Wound Magnetic Components
100%	57%	h.	Electronic Assemblies
57%	43%	i.	Electro-Mechanical Assemblies
14%	14%	j.	Electro-Optics
29%	29%	k.	Hardware
\-	\-	l.	Other _____

6. What percentage of your company's products are used in:
   _____ a. Military Applications
   _____ b. Commercial

7. If you currently have in use a method for providing standardization in design or manufacturing, it is:
   7% a. Formal And Automated
   36% b. Formal But Manual
   7% c. Informal
   29% d. None In Use
   7% e. Other Part Selection-formal-manual, CAD-formal-auto
   14% N/A

8. In order to be useful, an EC & C should support your work in the following areas:

	Very Useful	Useful	Somewhat Useful	Not Useful	N/A
a. Design Retrieval	14%	-	29%	14%	43%
b. Process Documentation	29%	42%	-	-	29%
c. Process Equipment Capacity Planning	-	71%	-	-	29%
d. New Processes/Designs	14%	14%	43%	-	29%
e. Cost Appraisal	29%	43%	14%	-	14%
f. Design Standards	29%	43%	14%	-	14%
g. Manufacturing Standards	43%	57%	-	-	-
h. Retrieval of Alternate Parts	42%	29%	-	-	29%
i. Obsolescence Appraisal	29%	29%	28%	-	14%
j. Have Ease of Maintenance	29%	29%	28%	-	14%

9. In your view, what is an acceptable time to retrieve critical design or process information required to perform your function?
   43% a. Seconds
   14% b. Minutes
   29% c. Hours
   14% d. Days

10. If your company implements an EC & C system, which of the following advantages would be important to realize:

	Primary	Secondary	Not Important	N/A
a. Increase Your Competitive Position	71%	29%	-	-
b. Increase Design Productivity	29%	71%	-	-
c. Increase Manufacturing Productivity	86%	14%	-	-
d. Lower Product Costs	71%	29%	-	-
e. Reduce Paperwork	29%	71%	-	-
f. Standardize Cost Evaluation Procedures	14%	72%	-	14%
g. Train Less Experienced Design/Mfg/ Test Engineers	43%	43%	-	14%
h. Identify Emerging/Advanced/Obsolete Processes and Materials	29%	57%	-	14%
i. Shorten Elapsed Time Between Design And Production	71%	29%	-	-
j. Utilize Knowledge & Experience of Existing Designs & Processes	72%	14%	-	14%
k. Inventory Reduction	58%	14%	14%	14%
l. Facilitate Automation of Manufacturing & Test Operations	57%	43%	-	-

11. In order to be valuable, an EC & C should use:

14%	a.	Industry Wide Normalized Data
43%	b.	Data Specific To Your Company
43%	c.	Both

12. How familiar are you with the concept of Group Technology?

-	a.	Work Or Have Worked With It
57%	b.	Familiar But Have Not Used It
43%	c.	Not Familiar With Group Technology

13. Rate the significance of each of the following as a major electronic family grouping:

	Primary	Secondary	Not Important	N/A
a. Packaging (panels, covers, chassis, etc.)	43%	43%	-	14%
b. Wired Assemblies (cables, harnesses, point to point)	71%	29%	-	-
c. Printed Wiring Boards	86%	14%	-	-
d. Discrete Components	43%	43%	-	14%
e. Integrated Circuits	57%	43%	-	-
f. Hybrid Microelectronics	57%	29%	-	14%
g. Wire Wound Magnetic Components	14%	43%	29%	14%
h. Electronic Assemblies	86%	14%	-	14%
i. Electro-Magnetic Assemblies	43%	43%	-	14%
j. Electro-Optics	29%	14%	43%	14%
k. Hardware	14%	58%	14%	14%
l. Other _____	-	-	-	-

Section 2

A. PACKAGING

DEFINITION: Packaging encompasses the elements (components/assemblies) which are required to create a "black box" which will contain electronic components, (i.e. panels, covers, chassis, etc.).

1. Rate the following characteristics as to whether they should be considered in developing an EC & C.

	Primary	Secondary	Not Important	N/A
a. Shape	29%	43%	14%	14%
b. Shape Elements (holes, slots, etc.)	43%	29%	14%	14%
c. Position of Shape Elements	14%	58%	14%	14%
d. Number of Various Shape Elements (quantity)	57%	29%	-	14%
e. Dimensions	57%	29%	-	14%
f. Tolerances	43%	43%	-	14%
g. Material	58%	14%	14%	14%
h. Major Machining Operations	58%	14%	14%	14%
i. Major Fabrication Operations	43%	29%	14%	14%
j. Surface Treatments	57%	29%	-	14%
k. Lot Size (quantity/time unit)	-	71%	-	29%
l. End Use of Package (internal, external)	14%	58%	14%	14%
m. Others _____	-	-	-	-

2. What testing and evaluation processes which apply to the packaging category should be considered by an EC & C?

Check all that are applicable.

86%	a.	Dimensional Analysis
29%	b.	Metallurgical/Material Evaluation
43%	c.	Stress/Strength Analysis
14%	d.	Color, Texture (Aesthetic Evaluation)
29%	e.	Static Dissipation
29%	f.	EMI Shielding
14%	g.	Other Persons who didn't answer (1)

B. WIRED ASSEMBLIES

Definition: An assembly consisting of multiconductor grouping of wires, point to point wiring, etched/additive wire assemblies, and/or flexible printed cables.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Number of Conductors	71%	29%	-	-
b. Size of Conductors	86%	14%	-	-
c. Type of End Terminations	100%	-	-	-
d. Type of Insulation	86%	14%	-	-
e. Type of Base Material	29%	71%	-	-
f. Type of Surface Plating	14%	72%	-	14%
g. Voltage/Current/Frequency Data	29%	57%	-	14%
h. Shielding	71%	29%	-	-
i. Dimensions	86%	-	-	14%
j. Number of Branches	29%	71%	-	-
k. Type (e.g. Flat, Ribbon, Coax)	72%	-	14%	14%
l. Lot Size (Quantity/Time Unit)	14%	43%	29%	14%
m. End Product Destination	14%	57%	29%	-
n. Machine Operations	42%	29%	29%	-
o. Manual Operations	29%	43%	14%	14%
p. Lot Size (Quantity/Time Unit)	14%	43%	14%	29%
q. Coating/Encapsulation	29%	57%	-	14%
r. Joining Processes	43%	43%	-	14%
s. Other _____	-	-	-	-

Wired Assemblies - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check all which apply

71%	a.	Dimensional
100%	b.	Opens/Shorts Testing
71%	c.	Impedence Testing
86%	d.	Hi-Pot Testing
29%	e.	Insulation Characteristics
43%	f.	Mechanical
14%	h.	Other UL/CSA Approved

C. PRINTED WIRING BOARDS (PWB)

Definition: A completely processed conductor pattern(s) all formed on a common base.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	43%	43%	-	14%
b. Dimensions	86%	-	-	14%
c. Lot Size (Quantity/Time Unit)	14%	58%	14%	14%
d. Tolerances	72%	14%	-	14%
e. Type of Base Material	72%	14%	-	14%
f. Type of Conductive Material	43%	29%	14%	14%
g. Conductor Electrical Characteristics	-	86%	-	14%
h. Environment Requirements	43%	43%	-	14%
i. Printed Circuitry Processes	29%	43%	14%	14%
j. Hole Information (Size, Quantity, etc.)	72%	14%	-	14%
k. Number of Layers	72%	14%	-	14%
l. Types of Layers	72%	14%	-	14%
m. Plating Information	29%	57%	-	14%
n. Masking & Coating	43%	43%	-	14%
o. Other _____	-	-	-	-

PWB - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check as apply

43%	a. Bond Evaluation (Layer)
43%	b. Bond Evaluation (Conductor)
71%	c. Metallurgical Evaluation of Plating Quality
-	d. Impedence
86%	e. Dimensional
86%	f. Electrical Testing
43%	g. Micro Sectioning
-	h. Other _____

D. DISCRETE COMPONENT

Definition: Any passive or active electronic component, other than integrated circuits and hybrid microelectronics. (e.g. capacitors, resistors, switches, diodes, transistors, etc.)

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Package	72%	14%	-	14%
b. Lead Configuration	72%	14%	-	14%
c. Package Dimension	72%	14%	-	14%
d. Parametric Specs	14%	58%	14%	14%

	Primary	Secondary	Not Important	N/A
e. Environmental Specs	14%	72%	-	14%
f. Adjustability	14%	58%	14%	14%
g. Component Type	72%	14%	-	14%
h. Lot Size (Quantity/Time Unit)	14%	58%	14%	14%
i. Other _____	-	-	-	14%

2. What test and evaluation processes should be considered by an EC & C:

Check all that apply

71% a. Parametric
86% b. Functional
14% c. Chemical/ Metallurgical Analysis (Leads and Package)
- d. Microsectioning
71% e. Dimensional
57% f. Environmental
- g. N/A

E. INTEGRATED CIRCUITS

Definition: A complex electronic semiconductor circuit, packaged as an individual component.

1. Rate the significance of the following charactristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type Of Packaging	86%	-	-	14%
b. Lead Arrangements	86%	-	-	14%
c. Number Of Leads	57%	29%	-	14%
d. Type By Function	86%	-	-	14%
e. Scale Of Integration, (LSI, SSI, etc).	14%	58%	14%	14%
f. Overall Package Dimensions	43%	43%	-	14%
g. Circuit Performance	29%	57%	-	14%
h. Environmental Requirements	43%	43%	-	14%
i. Lot Size (Quantity/Time Unit)	29%	29%	28%	14%
j. Other _____	-	-	-	14%

Integrated Circuits - Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C?

Check all which apply:

29% a. Fine/Gross Leak Test
71% b. Parametric Testing
71% c. Functional Testing
43% d. Pattern Sensitivity Testing
57% e. Temperature
86% f. Burn-In
43% g. Dynamic

h. 57% Static
i. 29% Product Application
j. 43% Temperature Cycling
k. - Other _____

F. HYBRID MICRO ELECTRONICS

Definition: A packaging technique that interconnects passive and/or semiconductor devices within a single package.

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C.

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	86%	-	-	14%
b. Lead Arrangement	72%	14%	-	14%
c. Number of Leads	57%	29%	-	14%
d. Internal Circuit Types	29%	57%	-	14%
e. Number of Internal Elements	43%	43%	-	14%
f. Package Dimensions	72%	14%	-	14%
g. Lead Related Dimensions	72%	14%	-	14%
h. Circuit Parametric Specs	43%	43%	-	14%
i. Lot Size (Quantity)	29%	29%	28%	14%
j. Environmental Specs	57%	29%	-	14%
k. Other _____	-	-	14%	-

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C.

Check all that apply

71% a. Physical Characteristics
71% b. Parametrics
100% c. Functional Testing
29% d. Static Testing
- e. Microsectioning
29% f. Pattern Sensitivity
29% g. Other (2) Heat generation, Dynamic Testing

G. WIRE WOUND MAGNETIC COMPONENTS

Definition: Any device which acts or reacts due to the electromagnetic field induced by current flowing through wire windings. This shall include transformers, actuators, rotary components and coils.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	29%	28%	-	43%
b. Function	43%	28%	-	29%
c. Dimensions	43%	28%	-	29%

	Primary	Secondary	Not Important	N/A
d. Electrical Data	28%	43%	-	29%
e. Winding Wire Data	29%	14%	14%	43%
f. Lamination Data	29%	14%	14%	43%
g. Adjustability	-	43%	14%	43%
h. Type of Shielding/Sleeving	14%	57%	-	29%
i. External Lead Data	14%	29%	14%	43%
j. Machine Processes	29%	28%	14%	29%
k. Major Fabrication Operations	14%	43%	14%	29%
l. Coating/Encapsulation	-	29%	28%	43%
m. Lot Size (Quantity/Time Unit)	14%	29%	14%	43%
n. Other _____	-	-	-	-

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C:

Check all which apply:

71%	a.	Induction
71%	b.	Impedence
43%	c.	Coupling
14%	d.	Load Effects
14%	e.	Excitation Current
14%	f.	Permeability
43%	g.	Voltage/Current/Frequency Data
57%	h.	Hi-Pot
29%	i.	Dimensions
29%	j.	Resistance
29%	k.	Other Person's who didn't answer (2)

H. ELECTRONIC ASSEMBLIES (EA)

Definition: A final assembly or second level assembly which includes a printed circuit board. These shall contain electronic, mechanical, and/or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	72%	-	14%	14%
b. Function	86%	14%	-	-
c. Tolerances	57%	29%	-	14%
d. Type of Composite Components	29%	43%	14%	14%
e. Number of Composite Components	43%	29%	14%	14%
f. Lot Size (Quantity/Time Unit)	14%	58%	14%	14%
g. Major Fabrication Operations	72%	14%	14%	-
h. Component Spacing Information	29%	57%	-	14%
i. Special Packaging	43%	43%	-	14%
j. Electrical Performance Specs	57%	29%	-	14%

	Primary	Secondary	Not Important	N/A
k. Special Environmental Requirements	57%	29%	-	14%
l. Coating/Encapsulation	43%	43%	-	14%
m. Other _____	-	14%	-	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

100%	a.	Functional Testing
100%	b.	In Circuit Testing
29%	c.	Parametrics
29%	d.	Dynamic Testing
14%	e.	In-Product Substitution
57%	f.	Environmental Chamber
14%	g.	Other (1) Environmental testing - Visual inspection

I. ELECTRO-MECHANICAL ASSEMBLIES

Definition: A final or secondary level assembly which performs an electronic function, but is manufactured using basically mechanical operations such as staking, riviting, screws, bolting and hard mounting of electronic or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Shape	72%	14%	-	14%
b. Functions(s)	57%	43%	-	-
c. Dimensions	72%	14%	-	14%
d. Lotsize (Quantity/Time Unit)	14%	58%	14%	14%
e. Type of Electronic Components	57%	43%	-	-
f. Quantity of Electronic Components	57%	43%	-	-
g. Type of Mechanical Components	43%	43%	14%	-
h. Quantity of Mechanical Components	43%	57%	-	-
i. Type of Electro-Optical Components	29%	43%	14%	14%
j. Quantity of Electro-Optical Components	29%	43%	14%	14%
k. Major Machining Operations	58%	14%	14%	14%
l. Major Assembly Operations	86%	14%	-	-
m. Coating/Encapsulation	29%	57%	-	14%
n. Joining Processes	71%	29%	-	-
o. Other _____	-	-	-	-

Test Evaluation

86%	a.	Functional Testing
43%	b.	Parametrics
43%	c.	Point To Point Internal Interconnections
43%	d.	Dynamic
-	e.	In-Product Substitution
-	f.	Other Mechanical

J. ELECTRO-OPTICS

Definition: Electronic device or assembly which integrates electrical and optical signal carrying medium.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Packaging	29%	14%	-	57%
b. Lead Configuration	43%	-	-	57%
c. Coupling Techniques	29%	14%	-	57%
d. Dimensions	14%	29%	-	57%
e. Performance	14%	29%	-	57%
f. Lot Size (Quantity/Time)	14%	29%	-	57%
g. Other _____	-	-	14%	-

2. What test and evaluation processes should be considered by an EC & C:

29% a. Dimensional
43% b. Signal Transmission
14% c. Parametrics
57% d. Other Person's who didn't answer

K. HARDWARE

Definition: Various electro-mechanical and mechanical components utilized in the different categories of assemblies (e.g. knobs, dials, connectors, etc.).

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important	N/A
a. Type of Hardware	86%	14%	-	-
b. Shape	72%	14%	-	14%
c. Mounting Technique	72%	14%	-	14%
d. Dimensions	57%	29%	-	14%
e. Base Material	14%	43%	29%	14%
f. Surface Treatment	-	72%	14%	14%
g. Machining Operations	43%	29%	14%	14%
h. Fabrication Operations	57%	29%	-	-
i. Lot Size (Quantity/Time Unit)	29%	29%	28%	14%
j. Custom or Standard	29%	43%	14%	14%
k. Other _____	-	-	14%	-

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

86% a. Dimensional
14% b. Metalurgical/Material
43% c. Aesthetics
14% d. Plating Analysis
14% e. Other Persons not answering

Section 6

VALIDATION OF DATA

6.1 Initial Survey Data Analysis

In order to validate the survey data, OIR project team members met on January 8-9, 1982 to perform an intial data analysis on those questionnaires returned by January 6, 1982.

The responses to the questionnaires were tabulated and raw data and preliminary percentage figures were established. This data was presented to the project team members for initial analysis.

During the two day technical review meeting, team members using their knowledge and expertise in Group Technology, analyzed the data. This analysis identified trends in the data and some answers which did not completely support Group Technology applications within the electronics industry. Review of the demographics demonstrated that only 12% of the respondents had intimate knowledge of Group Technology principles. The team identified areas which needed further exploration with electronics manufacturers.

6.2 Survey Data Validation Process

After completing the initial data analysis OIR proceeded to validate the findings of the survey through on-site interviews with electronics manufacturing companies. This activity met contract specifications and was a safeguard to make sure the project accurately reflected industry views regarding an ECACS.

Fifteen companies were identified as potential interview sites and interviews were scheduled and held at ten sites.

A team consisting of a Group Technology expert and an Electronics expert visited the ten companies, performed the interviews and kept detailed notes. The following format was used at each site:

- Presentation of an "overview of Group Technology". This provided quick information about the what, why, and how of Group Technology.
- Validation of survey findings by individual interviews with appropriate staff.

- Group discussion of the applications and implications of an ECACS.

This format educated respondents about Group Technology so that they could make better judgements about the information an ECACS should capture. Additionally, we encouraged electronics industry personnel to brainstorm about Group Technology applications in order for them to get a realistic view of the importance of such a coding system for their industry.

During the actual on-site interview sessions the following topics were specifically discussed.

- Verification of new designs or process plans generated yearly.
- Number of new designs or process plans generated yearly.
- Size of the engineering organization dedicated to generating the new designs or process plans.
- Size of engineering database.
- Distribution of engineering time between development and "other" activities.
- Primary applications for an Electronics Classification and Coding System which were perceived by the respondents.
- The scope of the development and implementation process reeded to support an Electronics Classification and Coding System.

6.3 On-Site Interview Notes

The following presents a summary of inputs received from the ten (10) on-site interviews.

Company #1

#1 has an annual sales volume of $20M and produces products which are primarily electronic and electro-mechanical.

It has a database, supporting electronics, of approximately 50,000 items of which 3,500 are electronic assemblies. This represents twice the normal average of components per assemblies. After some discussion, we found that there were many redundant part numbers, due to 75% of their design activity being external to #1 and the inability of Design to access the component database in order to identify those redundant data.

Lot sizes of $\leq$10 were typical, with approximately 40% of the assemblies having a second issue within a 12 month period.

Approximately 500 new electronic designs were produced annually. This required three full time process engineers to generate the supporting process plans.

The concensus of the Manufacturing Engineers interviewed was that the best applications of GT would be in the areas of:
- Cables
- PCBA
- Windings
- General Assembly

Design Engineering felt that the only potential application of GT was with discrete Components, and expressed considerable reservation regarding the effort required.

These results comply with the experience of established GT users:
- Wide need for application of GT oriented retrieval systems in the manufacturing engineering department because of the variety and volume of data that is handled.
- A need in the design engineering department to identify existing components that can do the job.
- A specific reluctance on the part of the design engineering department to work with cumbersome retrieval systems, mandating that a very user friendly retrieval system is needed for design engineers.

Company #2

#2 has annual sales of $90M with a product mix of 30% electro-mechanical and 70% electronics.

It has a database of approximately 35,000 items with 6,500 being assemblies. The manufacturing engineers felt that Design had access to the components database and that produced a high level of commonality. We were unable to meet

Company #2 - continued

with anyone from the Design organization to determine their process.

Lot sizes were typically less than 20 and the process leadtime was approximately 13 weeks.

Approximetely 1,200 new process plans and 1,400 changes were generated annually. This required 25% of the Manufacturing Engineering Organization, or 7 people.

Primary applications of GT, at #2, were felt to include:
- PCBA
- Chassis
- Electro-Mechanical Assembly

#2 felt they would have a real need for graphics capability to support the visuals and illustrations which they develop for their process plans, which were very complete.

The results of this interview indicate a higher level of interest in an ECACS and G.T. by manufacturing engineering than by design engineering. The data also confirm the need in manufacturing engineering for a better way to deal with vast amounts of different data. A high degree of detail is necessary in data manufacturing engineering. These details could be given by graphic representations.

Company #3

At #3, we met with a group of engineers from the "Advanced Systems Engineering" organization. Although they were not currently in a Design or Manufacturing role, due to their experience in those areas, they felt they could knowledgeably answer our questions.

Annual sales $ was not available. Their products included Military Avionics, Testers, and Commercial Airframes.

Lot sizes were typically 30-40 units and 90% of the orders were custom designed, to some degree.

The design group was project oriented and this was considered to be a cause of the redundancy in designs and components.

Approximately 1,500 active electronics assemblies were in the database.

Suggested GT applications included:
- Retrieve prior designs by function.
- Identify problem/success history for components.
- Identify vendor performance data by item.
- Retrieve specs relative to performance features.

Company #3 - continued

In addition to the apparent need to avoid design and component redundancy, the elements of product quality, product performance, and product obsolescence are entered as prime qualifiers. These qualifiers are measured in a diversified way. An ECACS should at least incorporate indicators for product quality/performance/obsolescence.

Company #4

This interview involved the Components Engineering group. #4 has a 9 month old effort underway to develop an ECACS for discrete components.

The component database has 7,000 items, which include active and passive devices, and some hardware. Items within the database have both an engineering (design) part number and a stock (significant) part number.

The access code to #4's Discrete Component database is "commodity code". This is generic code, grouping such items as capacitors, integrated circuits etc.. You would then search within the commodity code for the specific device you were seeking.

Characteristics captured in #4's database include:
- Lead configuration
- Scale of integration
- Circuit performance
- Functional Specs
- Adjustibility

However, the characteristics varied from one type of discrete to another.

The #4's system is an evolving process as evidenced by format changes over the past nine months. #4 is also expanding the database to include such things as purchase history, alternates part references, etc..

The fact that #4 started development of a commodity code for discrete components confirms the need to avoid redundancy in this area. Two other apparently common needs are indicatd by #4:

a. A requirement for detailed information about component configuration, preferably supported by graphic data.

b. A requirement for information for product quality performance and obsole cence. This information should preferably be kept in a separate section of their database.

Company #5

Annual sales data was not available. Products included PCBA, Wired Assemblies, and Black Boxes (final assemblies).

#5's database is composed of 23,000 items, 3,000 of which are electronics assemblies. The breakdown of assemblies is as follows:

- 1800 Wired Assy (harnesses)
- 250 Final Assy (black boxes)
- 950 PCBA & Electro-Mechanical Assy

Note: 1250 black boxes are purchased complete and would be contained in the remaining 20,000 of the database.

Approximately 500 new designs are generated yearly, with 1,400 changes to existing designs and are supported by 7 engineers. The process plans resulting from these designs are supported by 12 Process Planners, technical hourly personnel having considerable experience in the specific workcenter as operators, etc..

Lot sizes are typically 10 and the process leadtime is 13-17 weeks.

#5 is currently using a CAD System for PCB design and to generate NC tapes. Process plans are also supplemented with a general purpose instruction manual.

A high level of commonality, for parts, used in wired assemblies was noted. This was attributed to the significant amount of experience and communication between designers. The average age of the designers in this group was 50+ years.

GT applications perceived by #5 include:

1. Retrieve process plans (wired assy) from a database via a terminal with on-site print capability. A group of 4 people currently maintain a manual file of process plans within the Production Control section.

2. Create a database, with an efficient retrieval system, for critical design data for all assemblies and discrete components.

General: Average age of both designers and process planners was 50+ years and no program is yet underway to transfer their knowledge to an accessible database. A considerable interest was noted in harness assembly technology. The process, today, is virtually the same as it was 25 years ago.

Company #5 - continued

This interview indicates that in the design department avoidance of redundancy is actively pursued. As a result, the design engineers have developed a good appreciation for the potential of an efficient (GT oriented) retrieval system.
In design a need is expressed to retrieve some critical design data. In manufacturing engineering a need is expressed to retrieve more and more detailed data, like process plans.

Company #6

#6's sales were approximately $400M. The products were Navigation Systems for the Navy and Guidance Systems (missile) for the Air Force. The process included PCBA, mechanical assemblies, electro-mechanical assemblies, and semi to sophisticated test functions.

Our interviews were confined to the manufacturing engineering discipline.

The database is made up of 50,000 items, 20,000 assemblies and 30,000 components. The large number of assemblies is attributed to subcontract work accounting for 25% of the assembly items.

Approximately 1,800 process plans are generated yearly and supported by 12 process planners. The extent of changes, yearly, to process plans is 5,000.

Process leadtime is 6-8 weeks and the direct labor force is 1,000 people. Average lot sizes are less than 5 units.

Currently in use, at #6, are the following:

1. CAD for electronic components like PCB design and to generate artwork masters.

2. CAD for mechanical designs and tooling.

3. Item Identifier System - a home-grown discrete component database, with access by description.

Suggested applications included PCB, PCBA, Electro/Mechanical Assembly, Wired Assembly and Discrete Components.

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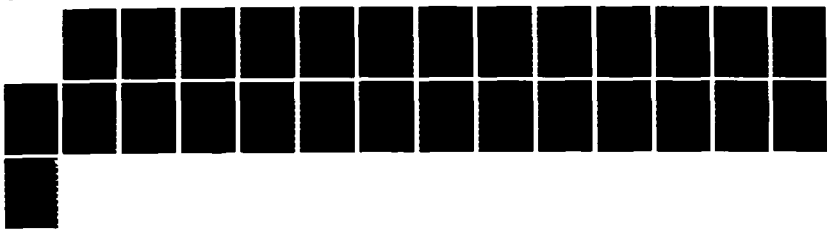

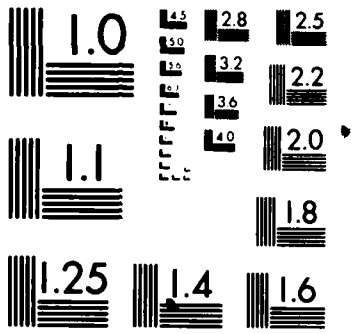

Company #6 - continued

The developments at this company do indicate a higher level of interest in an ECACS by manufacturing than by design. Currently, the first practical efforts to do data retrieval based on structured identification does occur for components.

The ratio of new process plans to changes in process plans with this company is about 1:3. This ratio seems to be typical for the industry. It does indicate that the management of change is an important task, and should possibly be included in ECACS - based retrieval systems.

Company #7

Sales data was not available. Products included satellites and related peripherals. Processes used included PCBA, Electro-Mechanical Assembly, Harnesses, Windings and Component Manufacturing.

#7's database contained 700,000 items, 140,000 being electronic assemblies and 560,000 being components.

New designs generated yearly amount to 5,000, with approximately 12,500 changes to existing designs. This activity is supported by 112 engineering personnel, or 25% of the design engineering organization.

The treatment of process plans was somewhat unique. #7 has 8,000 "Master" process plans supporting the 140,000 assemblies. They also have 250 process (generic) instruction. The 25, non-exempt, process planners retrieve these "Master" process plans, using their experience to determine which ones to draw onto a CRT screen. They then modify, to whatever degree necessary, that "Master" plan which most closely depicts the required process for the specific assembly they want to release. A printer then provides hard copy of the finished process plan for that assembly. A new "Master" process plan is generated only if a uniquely different design requiring a new process is generated.

Average lot sizes are <10 units, and there are about 40,000 lots released per year.

At this company the practical efforts geared towards avoidance of redundant effort occur at process planning. The concept of "Master" process plans is very close to a GT oriented process planning system. Basically an ECACS would provide, in this application the automated selection of the best "Master" process plan for the assembly under consideration.

Company #8

This interview was attended by a senior design engineer who had considerable experience in both the CAM and CAD sides. Company particulars, i.e. number of new designs, etc., were withheld as #8 felt that this was proprietary.

Processes used include Printed Circuit Board Assemblies, Electro-Mechanical Assemblies, Wired Assemblies, and Final Assembly. Sophisticated test processes where also used.

#8 has a design engineering staff of 450 with 30% of their time being dedicated to the creation of new designs.

Primary applications of GT, for both design and manufacturing, were felt to be:
- PCB
- PCBA
- E/M Assembly
- Final Assembly
- Discrete Components (including I.C.)

Company #9

This interview was attended by the Manager of PWB Design and Corporate CAD/CAM Applications. Our discussion was limited to the PWB and PWBA categories.

Processes used include both automatic and manual insertion of components on PWBA's. Lot sizes are greater than 500 and process leadtime is typically 4 weeks.

The database includes 5,000 components supporting 600 PWBA's. The data is increased annually by 84 new PWB designs. Each of these result in new process plans.

The design engineering staff consists of 25 people; a mixture of draftsmen, layout people and designers. Approximately 25% of their time is spent engaged in actual design work. This translates to 6 people producing 1.7 new designs per week.

Nearly 20% of the design engineers' time was spent on data search.

Company #9 - continued

#9 is in the process of making a considerable investment, approximately $3M, in CAD/CAM applications to facilitate the design process.

#9 is using these CAD/CAM systems to produce a final schematic and parts list; and then to develop the PCB layout. They also produce the artwork, router tapes, drill tapes, insertion tapes, and in some cases, the test tapes. This has produced a reduction of 88% of the time previously spent doing: layout, checking, digitizing, documenting and generation of tapes.

No real application in creating the original design has been implemented. They have, however, established design standards and have an approved components listing.

The primary application perceived was to develop an ability to simulate PCB schematics and layouts using CAD/CAM. This would probably draw on a database of prior designs and design standards for electrical and dimensional factors.

Company #10

This interview was attended by the engineer in charge of the CAD/CAM programs in the PWB area. All data is applicable to only the PWB's & PWBA categories.

Processes used included both automatic insertion and manual insertion. Lot sizes were typically >500, with process leadtime being 3-5 weeks depending on test requirements.

The database contains 26,600 items, 25,000 being components and the balance of 1,600 being PWBA's. Annually, 150 new PWB designs are created.

The design engineering organization consists of 17 people, 8 of which are design engineers. The design engineers spend 75% of their time engaged in actual design. This means that 15 people produce 3 designs per week.

Company #10 - continued

#10 uses a home-grown CAD software package. It is basically a "Schematic Capturing System" which:

- Eliminates draftsmen in schematics.
- Checks to insure design rules are satisfied.
- Checks for overloaded drivers.
- Checks for bad parts.

They also utilize commercially available CAD/CAM systems.

Point of manufacture, i.e. overseas versus U.S., was important to #10. This, apparently, influences UL compliance requirements.

Primary applications were perceived to include PWB, PWBA, Cables, and Electro-Mechanical Assemblies.

6.3 Summary Statistics/On-Site Interviews

	ITEMS IN DATABASE			NEW ISSUES/YEARLY				ISSUES PER ENGINEER		RATIO DOC/ENG		% DIST. OF ENG. TIME		(Col. #1 = Design) (Col. #2 = Process Plan) G. T. APPLICATIONS SUGGESTED									
														PCB		PCBA		E/M Assy.		Wired Assy.		Discrete Compo	
Company	Compo.	Assy	Ratio	Design	Design Change	Process Plans	Proc. Plan Changes	Design Eng.	Mfg. Eng.	D	P	Data Search	Develop										
#1	46.5K	3500	13/1	500	1,200	500	1200	-	8	-	63	15	33	No	X	No	X	No	X	No	X	X	X
#2	28.5K	6500	4.4/1	-	-	1200	1400	-	7	-	171	15	25	X	X	-	X	-	X	-	-	-	-
#3	-	1500	-	-	-	-	-	-	-	-	-	15	25	X	X	X	X	X	X	X	X	X	X
#4	7000	-	-	-	-	-	-	-	-	-	-	15	25	-	-	-	-	-	-	-	-	X	X
#5	20K	3000	6.7/1	500	1,400	500	1400	7	12	71	42	15	25	X	X	X	X	X	X	X	X	X	X
#6	30K	20K	1.5/1	-	-	1800	5000	-	12	-	150	25	33	X	X	-	X	-	X	-	X	-	X
#7	560K	140K	4/1	5000	12,500	-	-	112	-	45	-	15	30	X	X	X	X	X	X	X	X	X	X
#8	-	-	-	-	-	-	-	-	-	-	-	50	30	X	X	-	X	-	X	-	X	X	X
#9	5000	600	8.3/1	84	168	-	-	6	-	14	-	25	20	X	X	X	X	-	-	-	-	X	X
#10	25K	1600	15.6/1	150	300	-	-	15	-	10	-	15	75	X	X	X	X	-	-	-	-	X	X

Section 7

CONCLUSIONS

The OIR Project Team met on February 11-12, 1982 in order to review all the information collected by the project (including survey findings, on-site interviews, expertise of electronics experts etc.). The team analyzed all the data in order to determine the specifications for an ECACS. The following conclusions were reached as a result of this analysis.

7.1 Demographic Trends

- The largest population group in the total sample for the survey came from Manufacturing Engineering/Test Engineering representing 70% of the sample.

- The respondents to this survey were highly experienced professionals, with 90% having ten or more years of experience within the electronics industry.

- However, only 12% of the sample work or have worked with the concepts of Group Technology. This is a critical statistic to consider when reviewing the data regarding potential Group Technology applications, benefits, etc. This 12% figure confirmed the need for validation of survey data through on-site interviews.

- Only 10% of the respondents indicated that their companies had a formal and automated method for providing for standardization in electronics design or manufacture. However, 45% indicated the existance of formal but manual systems; therefore 55% of the respondents' companies were approaching standardization through formal methodology. 25% of the respondents indicated that informal methods for approaching standardization were in place. Overall, 80% of the respondents indicated that standardization was a real concern and some attempt was being made to address this issue. These statistics were corroborated by the on-site interviews.

7.2 Electronics Classification and Coding System: General Trends

- The primary advantages of using an ECACS were perceived to be:
  - lower overall product cost.
  - increase manufacturing productivity.
  - shorten elapsed time between design and production.
  - utilize knowledge and experience of existing designs and processes.
  - increase design productivity.

- In order to be valuable, 73% of the participants felt that an ECACS should use both industry-wide normalized data and data specific to a company. This means that an ECACS should provide a "common language" to identify data from different sources.

- The categories identified as family groupings by the questionnaire appeared to be comprehensive as no participant felt any additional grouping was required.

- No formal application of an ECACS was found. Although databases were being created, retrieval was always a function of experience and personal knowledge. The closest system to an ECACS that we were able to identify was the accessing of a Discrete Components database by "commodity code." This, however, resulted in the retrieval of a large number of items.

- For assemblies, in general, the following characteristics were primary:
  Function/Type
  Performance Specifications
  Performance History
  Assembly Technology
  Dimensions

- Primary applications of ECACS:

Family	% Company Responding Positively	
	Design	Process
PCB	90	100
PCBA	84	100
Elec/Mech	75	100
Wired/Assy.	75	100
Discretes	80	100

- It could be expected that only 30% of the perceived ECACS applications would be found in design because 30% of the respondents are design engineers. However, a very high potential for applications was found in the design area. Apparently the manufacturing and/or test engineers experience the results of redundant designs as additional production effort and cost.

  This does comply with the experience of established G.T. users where, quite often, the cost of manufacturing provides the driving force for reducing design proliferation.

- The ratio of components to asemblies is 8 to 1. This is attributed to common and repeat usage of a given component. This does indicate that the components section of ECACS should contain more detail than the assembly section.

7.3 Related Concerns/Projects to ECACS

- Current activities underway aimed at utilizing CAD/CAM:
  - Graphics application for PWB, tools, and fixture design.
  - Retrieval of approved components listing.
  - Design standards are being formalized and loaded to database.
  - Graphics software is used to generate NC tapes for routers, drilling, insertion & test.
  - "Master" process plans are being maintained, one serving 15-17 unique assembly items, with minor editing to the master.

- Approximately 75% of the Design and/or Manufacturing Engineer's time is spent doing things other than development. The major reason for this low productivity can be attributed to the informal support systems and the resulting time spent in data search.

- Apparently the main concern of design engineers is having a fast retrieval system available that will provide them with existing designs. The major area of practical interest seems to be discrete components, including I/C's.

- The needs of manufacturing and test engineers are not limited to a fast retrieval system for similar parts. Manufacturing and Test Engineering want an ECACS to provide the following related data:
  - Graphic representation of the part.
  - Ability to reference "Master" process plans.
  - Quality/performance/obsolescence data.

- A very strong interest was noted, at the aircraft companies visited, to find a way to document, in a retrievable format, the tremendous amount of information available only in the heads of their key design and process planning engineers. The majority of the engineering personnel at these companies were observed to be in the low to mid 50's age group, while in other industries the average age was approximately 15 years younger.

- The survey does indicate that an ECACS and retrieval system are not enough to serve all needs. Careful consideration should be given to the type of data that should be retrieved by ECACS. In other words, an ECACS is incomplete without an application database. The application database should be readily accessible for statistical analysis.

- A real need exists for Group Technology applications and an ECACS in electronics manufacturing. This is evidenced by the numerous efforts underway, in all companies visited, to develop CAD/CAM applications. Current attempts at developing an ECACS are company specific and are usually limited to one area of electronics manufacture.

  The feasibility of developing an ECACS with industry wide appeal is becoming a reality. The construction of such a code will be a major project which will require the cooperation of the electronics industry coupled with Group Technology expertise. The anticipated significant increases in productivity and cost savings generated by Group Technology applications within electronics make this a high priority project.

APPENDICES

APPENDIX A

December 1, 1981

Dear Survey Participant:

Many corporations and U.S. Government organizations, cognizant of the benefits of Group Technology applications in the machine shop, have expressed strong interest in applying Group Technology principles to the design, manufacture and test of electronic components and assemblies.

The Organization for Industrial Research, Inc. (OIR), a leader in the field of Group Technology and CAD/CAM Systems, and the U.S. Army believe the initial step to GT applications in electronics is a classification and coding system specifically designed for the electronics industry. In order to develop an Electronics Classification and Coding System (EC & C) it is necessary to identify the parameters for such a code. It is essential to define which attributes an EC &C system should capture.

The enclosed survey attempts to identify the parameters for an EC & C System and has been sent to leading electronics manufacturers in the U.S. If you decide to participate, OIR will share the survey results with all companies who contribute. OIR anticipates the design, manufacture and test functions will benefit significantly from GT applications in the electronics industry. We are fully aware of the necessity of getting up to date, state of the art input concerning an EC & C System before beginning development. We look forward to receiving your response. Thank you for your participation.

Sincerely,

A. Hoitzeel,
President

AH:jh
encl.

APPENDIX B

QUESTIONNAIRE COMPLETION INSTRUCTIONS

Your participation in this survey is greatly appreciated. Please complete this questionnaire according to these guidelines.

- Question 1 asks for your company name and your title. This information is for our use only. If you complete this section, we will be glad to send your company the results of this survey., If you would rather remain totally anonymous, omit this question.

- Answer all questions to the best of your knowledge. If some questions are outside of your specialty area, feel free to skip those questions.

- Use the stamped, self-addressed envelope to return your questionnaire to OIR by December 15, 1981.

Your input is critical to this project, thank you for your participation.

ELECTRONICS CLASSIFICATION AND CODING SYSTEM SURVEY

Section 1

1. Name _____
   Company _____
   Position _____

2. Your present position is primarily involved with:
   ____ a. Electronic Product Design
   ____ b. Electronic Product Manufacturing
   ____ c. Electronic Product Testing
   ____ d. Other _____

3. In which of the following areas do you have experience?
   ____ a. Methods Engineering
   ____ b. Manufacturing Engineering
   ____ c. Process Engineering
   ____ d. Design Engineering
   ____ e. Test Engineering
   ____ f. Development Engineering
   ____ g. Research
   ____ h. Industrial Engineering
   ____ i. Product Support Engineering
   ____ j. Other _____

4. How many years of experience do you have in the electronics industry?
   ____ a. Up to 5
   ____ b. 6 to 10
   ____ c. 11 to 20
   ____ d. More than 20

5. In which areas of electronics design/manufacturing do you have direct experience? (Check all that apply).

Present Job	Previous Jobs		
_____	_____	a.	Packaging (panels, covers, chassis, etc.)
_____	_____	b.	Wired Assemblies (cables, harnesses, point to point etc.)
_____	_____	c.	Printed Wiring Boards
_____	_____	d.	Discrete Components
_____	_____	e.	Integrated Circuits
_____	_____	f.	Hybrid Microelectronics
_____	_____	g.	Wire Wound Magnetic Components
_____	_____	h.	Electronic Assemblies
_____	_____	i.	Electro-Mechanical Assemblies
_____	_____	j.	Electro-Optics
_____	_____	k.	Hardware
_____	_____	l.	Other _____

6. What percentage of your company's products are used in:
   _____ a. Military Applications
   _____ b. Commercial

7. If you currently have in use a method for providing standardization in design or manufacturing, it is:
   _____ a. Formal And Automated
   _____ b. Formal But Manual
   _____ c. Informal
   _____ d. None In Use
   _____ e. Other _____

8. In order to be useful, an EC & C should support your work in the following areas:

	Very Useful	Useful	Somewhat Useful	Not Useful
a. Design Retrieval	____	____	____	____
b. Process Documentation	____	____	____	____
c. Process Equipment Capacity Planning	____	____	____	____
d. New Processes/Designs	____	____	____	____
e. Cost Appraisal	____	____	____	____
f. Design Standards	____	____	____	____
g. Manufacturing Standards	____	____	____	____
h. Retrieval of Alternate Parts	____	____	____	____
i. Obsolescence Appraisal	____	____	____	____
j. Have Ease of Maintenance	____	____	____	____

9. In your view, what is an acceptable time to retrieve critical design or process information required to perform your function?
   ____ a. Seconds
   ____ b. Minutes
   ____ c. Hours
   ____ d. Days

10. If your company implements an EC & C system, which of the following advantages would be important to realize:

	Primary	Secondary	Not Important
a. Increase Your Competitive Position	___	___	___
b. Increase Design Productivity	___	___	___
c. Increase Manufacturing Productivity	___	___	___
d, Lower Product Costs	___	___	___
e. Reduce Paperwork	___	___	___
f. Standardize Cost Evaluation Procedures	___	___	___
g. Train Less Experienced Design/Mfg/ Test Engineers	___	___	___
h. Identify Emerging/Advanced/Obsolete Processes and Materials	___	___	___
i. Shorten Elapsed Time Between Design And Production	___	___	___
j. Utilize Knowledge & Experience of Existing Designs & Processes	___	___	___
k. Inventory Reduction	___	___	___
l. Facilitate Automation of Mfg & Test Operations	___	___	___

11. In order to be valuable, an EC & C should use:
    ____ a. Industry Wide Normalized Data
    ____ b. Data Specific To Your Company
    ____ c. Both

12. How familiar are you with the concept of Group Technology?
    ____ a. Work Or Have Worked With It
    ____ b. Familiar But Have Not Used It
    ____ c. Not Familiar With Group Technology

13. Rate the significance of each of the following as a major electronic family grouping:

	Primary	Secondary	Not Important
a. Packaging (panels, covers, chassis, etc.)	____	____	____
b. Wired Assemblies (cables, harnesses, point to point)	____	____	____
c. Printed Wiring Boards	____	____	____
d. Discrete Components	____	____	____
e. Integrated Circuits	____	____	____
f. Hybrid Microelectronics	____	____	____
g. Wire Wound Magnetic Components	____	____	____
h. Electronic Assemblies	____	____	____
i. Electro-Magnetic Assemblies	____	____	____
j. Electro-Optics	____	____	____
k. Hardware	____	____	____
l. Other _____	____	____	____

Section 2

A. PACKAGING

DEFINITION: Packaging encompasses the elements (components/assemblies) which are required to create a "black box" which will contain electronic components, (i.e. panels, covers, chassis, etc.).

1. Rate the following characteristics as to whether they should be considered in developing an EC & C.

	Primary	Secondary	Not Important
a. Shape	____	____	____
b. Shape Elements (holes, slots, etc.)	____	____	____
c. Position of Shape Elements	____	____	____
d. Number of Various Shape Elements (quantity)	____	____	____
e. Dimensions	____	____	____
f. Tolerances	____	____	____
g. Material	____	____	____
h. Major Machining Operations	____	____	____
i. Major Fabrication Operations	____	____	____
j. Surface Treatments	____	____	____
k. Lot Size (quantity/time unit)	____	____	____
l. End Use of Package (internal, external)	____	____	____
M. Others _____	____	____	____

2. What testing and evaluation processes which apply to the packaging category should be considered by an EC & C?

Check all that are applicable.

____ a. Dimensional Analysis
____ b. Metallurgical/Material Evaluation
____ c. Stress/Strength Analysis
____ d. Color, Texture (Aesthetic Evaluation)
____ e. Static Dissipation
____ f. EMI Shielding
____ g. Other _____

B. WIRED ASSEMBLIES

Definition: An assembly consisting of multiconductor grouping of wires, point to point wiring, etched/additive wire assemblies, and/or flexible printed cables.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C.

	Primary	Secondary	Not Important
a. Number of Conductors	____	____	____
b. Size of Conductors	____	____	____
c. Type of End Terminations	____	____	____
d. Type of Insulation	____	____	____
e. Type of Base Material	____	____	____
f. Type of Surface Plating	____	____	____
g. Voltage/Current/Frequency Data	____	____	____
h. Shielding	____	____	____
i. Dimensions	____	____	____
j. Number of Branches	____	____	____
k. Type (e.g. Flat, Ribbon, Coax)	____	____	____
l. Lot Size (Quantity/Time Unit)	____	____	____
m. End Product Destination	____	____	____
n. Machine Operations	____	____	____
o. Manual Operations	____	____	____
p. Lot Size (Quantity/Time Unit)	____	____	____
q. Coating/Encapsulation	____	____	____
r. Joining Processes	____	____	____
s. Other _____	____	____	____

Wired Assemblies - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check all which apply

____ a. Dimensional
____ b. Opens/Shorts Testing
____ c. Impedence Testing
____ d. Hi-Pot Testing
____ e. Insulation Characteristics
____ f. Mechanical
____ g. Joining Processes
____ h. Other _____

C. PRINTED WIRING BOARDS (PWB)

Definition: A completely processed conductor pattern(s) all formed on a common base.

1. Rate the following characteristics as to whether they should be considered a variable in relation to an EC & C:

	Primary	Secondary	Not Important
a. Shape	____	____	____
b. Dimensions	____	____	____
c. Lot Size (Quantity/Time Unit)	____	____	____
d. Tolerances	____	____	____
e. Type of Base Material	____	____	____
f. Type of Conductive Material	____	____	____
g. Conductor Electrical Characteristics	____	____	____
h. Environment Requirements	____	____	____
i. Printed Circuitry Processes	____	____	____
j. Hole Information (Size, Quantity, etc.)	____	____	____
k. Number of Layers	____	____	____
l. Types of Layers	____	____	____
m. Plating Information	____	____	____
n. Masking & Coating	____	____	____
o. Other _____	____	____	____

PWB - Test/Evaluation

2. What testing and evaluation processes should be considered by an EC & C:

Check as apply

____ a. Bond Evaluation (Layer)
____ b. Bond Evaluation (Conductor)
____ c. Metallurgical Evaluation of Plating Quality
____ d. Impedence
____ e. Dimensional
____ f. Electrical Testing
____ g. Micro Sectioning
____ h. Other _____

D. DISCRETE COMPONENT

Definition: Any passive or active electronic component, other than integrated circuits and hybrid microelectronics. (e.g. capacitors, resistors, switches, diodes, transistors, etc.)

1. Rate the significance of th following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Type of Package	____	____	____
b. Lead Configuration	____	____	____
c. Package Dimension	____	____	____
d. Parametric Specs	____	____	____

	Primary	Secondary	Not Important
e. Environmental Specs	____	____	____
f. Adjustability	____	____	____
g. Component Type	____	____	____
h. Lot Size (Quantity/Time Unit)	____	____	____
i. Other _____	____	____	____

2. What test and evaluation processes should be considered by an EC & C:

Check all that apply

____ a. Parametric
____ b. Functional
____ c. Chemical/ Metallurgical Analysis (Leads and Package)
____ d. Microsectioning
____ e. Dimensional
____ f. Environmental
____ g. Other

E. INTEGRATED CIRCUITS

Definition: A complex electronic semiconductor circuit, packaged as an individual component.

1. *Rate the significance of the following charactristics as to whether they should be considered a variable in relation to an EC & C.*

	Primary	Secondary	Not Important
a. Type Of Packaging	____	____	____
b. Lead Arrangements	____	____	____
c. Number Of Leads	____	____	____
d. Type By Function	____	____	____
e. Scale Of Integration, (LSI, SSI, etc).	____	____	____
f. Overall Package Dimensions	____	____	____
g. Circuit Performance	____	____	____
h. Environmental Requirements	____	____	____
i. Lot Size (Quantity/Time Unit)	____	____	____
j. Other _____	____	____	____

Integrated Circuits - Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C?

Check all which apply:

____ a. Fine/Gross Leak Test
____ b. Parametric Testing
____ c. Functional Testing
____ d. Pattern Sensitivity Testing
____ e. Temperature
____ f. Burn-In
____ g. Dynamic

h. ____ Static
i. ____ Product Application
j. ____ Temperature Cycling
k. ____ Other _____

F. HYBRID MICRO ELECTRONICS

Definition: A packaging technique that intrconnects passive and/or semiconductor devices within a single package.

1. Rate the significance of the following characteristics as to whether they should be considered by an EC & C.

	Primary	Secondary	Not Important
a. Type of Packaging	____	____	____
b. Lead Arrangement	____	____	____
c. Number of Leads	____	____	____
d. Internal Circuit Types	____	____	____
e. Number of Internal Elements	____	____	____
f. Package Dimensions	____	____	____
g. Lead Related Dimensions	____	____	____
h. Circuit Parametric Specs	____	____	____
i. Lot Size (Quantity)	____	____	____
j. Environmental Specs	____	____	____
k. Other _____	____	____	____

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C.

Check all that apply

____ a. Physical Characteristics
____ b. Parametrics
____ c. Functional Testing
____ e. Static Testing
____ f. Microsectioning
____ g. Pattern Sensitivity
____ h. Other _____

G. WIRE WOUND MAGNETIC COMPONENTS

Definition: Any device which acts or reacts due to the electromagnetic field induced by current flowing through wire windings. This shall include transformers, actuators, rotary components and coils.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Shape	____	____	____
b. Function	____	____	____
c. Dimensions	____	____	____

	Primary	Secondary	Not Important
d. Electrical Data	____	____	____
e. Winding Wire Data	____	____	____
f. Lamination Data	____	____	____
g. Adjustability	____	____	____
h. Type of Shielding/Sleeving	____	____	____
i. External Lead Data	____	____	____
j. Machine Processes	____	____	____
k. Major Fabrication Operations	____	____	____
l. Coating/Encapsulation	____	____	____
m. Lot Size (Quantity/Time Unit)	____	____	____
n. Other _____	____	____	____

Test/Evaluation

2. What test and evaluation processes should be considered by an EC & C:

Check all which apply:

____ a. Induction
____ b. Impedence
____ c. Coupling
____ d. Load Effects
____ e. Excitation Current
____ f. Permeability
____ g. Voltage/Current/Frequency Data
____ h. Hi-Pot
____ i. Dimensions
____ j. Resistance
____ k. Other _____

H. ELECTRONIC ASSEMBLIES (EA)

Definition: A final assembly or second level assembly which includes a printed circuit board. These shall contain electronic, mechanical, and/or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Shape	____	____	____
b. Function	____	____	____
c. Tolerances	____	____	____
d. Type of Composite Components	____	____	____
e. Number of Composite Components	____	____	____
f. Lot Size (Quantity/Time Unit)	____	____	____
g. Major Fabrication Operations	____	____	____
h. Component Spacing Information	____	____	____
i. Special Packaging	____	____	____
j. Electrical Performance Specs	____	____	____

	Primary	Secondary	Not Important
k. Special Environmental Requirements	____	____	____
l. Coating/Encapsulation	____	____	____
m. Other _____	____	____	____

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

____ a. Functional Testing
____ b. In Circuit Testing
____ c. Parametrics
____ d. Dynamic Testing
____ e. In-Product Substitution
____ f. Environmental Chamber
____ g. Other _____

I. ELECTRO-MECHANICAL ASSEMBLIES

Definition: A final or secondary level assembly which performs an electronic function, but is manufactured using basically mechanical operations such as staking, riviting, screws, bolting and hard mounting of electronic or optical components.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Shape	____	____	____
b. Functions(s)	____	____	____
c. Dimensions	____	____	____
d. Lotsize (Quantity/Time Unit)	____	____	____
e. Type of Electronic Components	____	____	____
f. Quantity of Electronic Components	____	____	____
g. Type of Mechanical Components	____	____	____
h. Quantity of Mechanical Components	____	____	____
i. Type of Electro-Optical Components	____	____	____
j. Quantity of Electro-Optical Components	____	____	____
k. Major Machining Operations	____	____	____
l. Major Assembly Operations	____	____	____
m. Coating/Encapsulation	____	____	____
n. Joining Processes	____	____	____
o. Other_____	____	____	____

Test Evaluation

____ a. Functional Testing
____ b. Parametrics
____ c. Point To Point Internal Interconnections
____ d. Dynamic
____ e. In-Product Substitution
____ f. Other _____

J. ELECTRO-OPTICS

Definition: Electronic device or assembly which integrates electrical and optical signal carrying medium.

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Type of Packaging	____	____	____
b. Lead Configuration	____	____	____
c. Coupling Techniques	____	____	____
d. Dimensions	____	____	____
e. Performance	____	____	____
f. Lot Size (Quantity/Time)	____	____	____
g. Other _____	____	____	____

2. What test and evaluation processes should be considered by an EC & C:

____ a. Dimensional
____ b. Signal Transmission
____ c. Parametrics
____ d. Other _____

K. HARDWARE

Definition: Various electro-mechanical and mechanical components utilized in the different categories of assemblies (e.g. knobs, dials, connectors, etc.).

1. Rate the following characteristics as to whether they should be considered by an EC & C:

	Primary	Secondary	Not Important
a. Type of Hardware	____	____	____
b. Shape	____	____	____
c. Mounting Technique	____	____	____
d. Dimensions	____	____	____
e. Base Material	____	____	____
f. Surface Treatment	____	____	____
g. Machining Operations	____	____	____
h. Fabrication Operations	____	____	____
i. Lot Size (Quantity/Time Unit)	____	____	____
j. Custom or Standard	____	____	____
k. Other _____	____	____	____

Test Evaluation

2. What test and evaluation processes should be considered by an EC & C:

____ a. Dimensional
____ b. Metalurgical/Material
____ c. Aesthetics
____ d. Plating Analysis
____ e. Other _____

SECTION 3

COMMENTS

1. How do you feel about the application of Group Technology and an EC & C system in the electronics industry? (Optional)

2. If there are any issues or topics important to the development of an Electronics Classification and Coding System which this survey has not covered, please identify. If there are any comments you wish to add, please do so. Thank you for your participation.

APPENDIX C

Survey Participants/Primary Contacts

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